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PLENARY SPEAKERS

Id-075

Plenary Talk: 20 Years of Commercializing Nanomedicine: Real Patients with Real Results

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Abstract: There is an acute shortage of organs due to disease, trauma, congenital defect, and most importantly, age related maladies. While tissue engineering (and nanotechnology) has made great strides towards improving tissue growth, infection control has been largely forgotten. Critically, as a consequence, the Centers for Disease Control have predicted more deaths from antibiotic-resistant bacteria than all cancers combined by 2050. Moreover there has been a lack of translation to real commercial products. This talk will summarize how nanotechnology can be used to increase tissue growth and decrease implant infection without using antibiotics (while getting regulatory approval). Our group has shown that same nanofeatures, nano-modifications, and nanoparticles can reduce bacterial growth without using antibiotics. This talk will summarize techniques and efforts to create nanofeatures for a wide range of medical devices and tissue engineering applications, particularly those that have received FDA approval and are currently being implanted in humans.

Keywords: nanomaterials, antibacterial, anti inflammatory, and tissue engineering

INVITED SPEAKERS

Id-058

Chitosan-Based Hydrogels as Biomaterials for Controlled Release

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Abstract: Because of its favorable properties chitosan has been studied as a biomaterial and as a pharmaceutical excipient in drug formulations. For this, chitosan has to be crosslinked either chemically using covalent agents, or physically with ionic agents. The use of crosslinking agents is imposed by the properties of the non-crosslinked gels, such as lack of shape and mechanical stability. It is well-known that the covalent crosslinking agents present a certain toxicity leading to cytotoxic formulations. To reduce this toxicity original concepts were developed. The first one to be described was double-crosslinking consisting in a mixture of covalent (glutaraldehyde was used in a minimum amount to ensure the system stability) and ionic (sodium or magnesium sulphate, sodium tripolyphosphate) crosslinking agents. A second concept is the use of natural non toxic crosslinking agents such as tannic acid. Due to hydrogen interactions able to form with the polysaccharides, tannic acid is able to prepare hydrogels able to load and deliver drugs or biologically active matter. These materials can be prepared under different forms such as hydrogels, particles and capsules. Their properties depend on some initial preparation parameters, the aqueous solution concentration, the process conditions, etc. Specific tests were performed in order to prove the ability of these biomaterials to be used in different areas of medicine. But drug release studies on these materials show, in many cases, a burst effect phenomenon. A great quantity of active principle is released in the first minutes before release rate stays constant. This effect leads to a great initial drug concentration in the body and decreases the lifetime of the system. According to applications it may be desired (wound dressing) or, very often, negative. To overcome this problem liposome dispersed in the hydrogel were used playing the role of supplementary barrier against early drug release. Complex systems capable of prolonged and controlled drug release kinetics were prepared based on chitosan hydrogels and drug loaded liposomes. Calcein release from polymeric hydrogels has been retarded from several days to weeks after calcein inclusion in small phosphatidylcholine unilamellar and multilamellar vesicles entrapped subsequently in hydrogels. The calcein release kinetics of complex systems was compared to simple systems (control hydrogels) and important changes were observed proving that the mechanism of the process increases in complexity. Kinetic constants obtained from Higuchi or Korsmeyer-Peppas models were compared and discussed. Moreover, it is demonstrated that liposomes' stability can be greatly improved by inclusion in polymer matrices.

Keywords: Chitosan, hydrogels, controlled release

INVITED SPEAKERS

Id-065

Laccases as Versatile Tools for the Functionalisation of Lignocellulose Materials

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Abstract: Over the years lignocellulose materials such as wood have been used extensively mainly because of desirable properties such as aesthetic appearance, low density, low thermal expansion and low energy requirement to produce a usable end product. However, lignocellulose materials are naturally hydrophilic and are prone to biodeterioration, and may need to be modified to suit specific functional requirements. The physico-chemical methods that have traditionally been used to improve functional properties are becoming increasingly unpopular as society becomes eco-and energy-sensitive. The objective of this work was to develop new enzymatic processes for the functionalization of lignocellulose materials. Using laccases, hydrophobicity enhancing and antimicrobial functional molecules were grafted onto lignocellulose materials directly through radical-radical coupling, targeting lignin moieties or indirectly via anchor groups carrying reactive functional groups. Mechanistic evidence of coupling was provided using lignin model compounds guaiacylglycerol β-guaiacyl ether, syringylglycerol β-guaiacyl ether, dibenzodioxocin and coniferyl alcohol, to mimic the reactions in solution. The functional molecules were coupled predominantly through 5-5 linkages when guaiacylglycerol β-guaiacyl ether, coniferyl alcohol or dibenzodioxocin were used as model compounds whereas coupling to syringylglycerol β-guaiacyl ether occurred through 4-O-5 linkages. An alternative non-selective method based on oxiranes as reactive anchor groups showed superior functionalization of selected lignocellulose materials with long chain alkylamines. Similarly, the approach could be used for introducing fatty acid esters in wood leading to increased hydrophobicity. These approaches present a mild and ‘green’ way of modifying lignocellulose materials and since the functional molecules are covalently bound to lignocellulose materials, they are not readily released into the environment.

Keywords: lignocellulose materials, hydrophilic, biodeterioration

INVITED SPEAKERS

Id-073

Poly(*N,N*-diethylaminoethyl methacrylate) Based Polymers and Gold Nanoparticles: A Convenient Combination for Drug Delivery To Cancer Cells

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Abstract: It is well-known that positively charged nanoparticles (NPs) are more readily internalized by cells than neutral and negatively charged NPs [1]. For example, amine-containing polymers can act as proton sponges, leading to an influx of electrolytes and, consequently, to osmotic swelling and lysosomal rupture, and finally, to the rapid release of the drug into the cytoplasm. This was demonstrated by Xu et al. [2] in a study using poly(*N,N*-diethylaminoethyl methacrylate) (PDEAEM) block copolymers with polyethyleneglycol (PEG) that form micelles.

Gold nanorods (GNRs) have received increasing interest in biomedical applications, such as drug delivery systems (DDS) and in photothermal therapy, due to the high specificity, non-invasive and low toxicity nature of the light stimulus [3]. GNRs also demonstrate structure-dependent optical properties, with tunable photothermal response to light [4]. In the present contribution two types of PDEAEM containing polymer architectures were developed with the goal to provide drug-delivery systems capable of deliver not only drugs but also gold nanoparticles that can aid to establish in the future a system for dual chemo-photothermal therapy against cancer: First, cationic PDEAEM nanogels provided with a polyethyleneglycol shell were prepared varying the ratio of PDEAEM to PEG, the initiator and the crosslinker used; resulting in nanogels of different surface charge and hydrodynamic diameter. Nanogels were also studied loaded with gold nanoparticles; and second polymersomes have been designed to combine the biocompatibility and hidrophilicity of PEG, with the ability to load hydrophilic and hydrophobic drugs and responsiveness to biologically relevant stimuli such as pH and temperature provided by PDEAEM. Two well-known chemotherapeutic drugs, 5-fluoruracil and Doxorubicin, were loaded together with gold nanoparticles and gold nanorods and tested against two cancer cell lines: HCT-116 (Colon cancer) and NCI-H1437 (Lung cancer). Results showed that the cell viability depended on polymer nanocarrier composition, surface charge, type of gold nanoparticle and irradiation/no-irradiation procedures. Nanogels without PEG (100% PDEAEM) and nanogels containing 45 wt% of PDEAEM were cytotoxic to different cell lines. Nanogels containing 20 wt% or less of PDEAEM provided with a PEG-shell were non cytotoxic even at relatively high concentrations. These nanogels loaded with 5-fluorouracil turned to be cytotoxic against the HCT-116 cell-line provoking cell death by apoptosis.

The irradiation studies on the present work, using a sapphire laser (780 nm, 200 mW) showed a temperature increment of 7 ºC starting at 37 ºC. The observed temperature increase was enough to allow a higher drug release in the NCI-H1437 cells, observing a significant difference in the cell viability between the non-irradiated and the irradiated cells that contained gold nanorods and no difference between the irradiated and not irradiated control cells.

Keywords: Nanoparticles, amine-containing polymers, gold nanorods, cationic PDEAEM nanogels

References

[1]. R.R. Arvizo, O.R. Miranda, M.A. Thompson, C.M. Pabelick, R. Bhattacharya, J.D. Robertson, *V.M. Rotello, Y.S. Prakash, and P. Mukherjee. Nano Lett. 10, 2543 (2010).*

[2]. P. Xu, E.A. Van Kirk, W.J. Murdoch, Y. Zhan, D.D. Isaak, M. Radosz, and Y. Shen. *Biomacromolecules* 7, 829 (2006).

[3]. Jerome, C.; Duguet, E.; Detrembleur, C.; Liu, J.; De Pauw-Gillet, M.; Mornet, S. *Polym. Chem*. 5, 799 (2014).

[4]. [Xia, Y.; Yang, X.; Yang, M.; Pang, B.; Vara, M. *Chem. Rev*. 115, 10410 (2015).

INVITED SPEAKERS

Id-077

Feasibility of Micro-Nanotechnology in Biomedical Applications

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Abstract: Micro-Nanotechnology (MNT) has the potential to alter daily life in much the same way that modern utilities have. MNT as the core of every single device will have a deep impact on many activities that will be developed and upgraded, including but not limited to medicine, food, sports, and edifices, etc. MNT is capable to perform what no one has ever imagined or even thought possible. Accordingly, a new generation will come to light with new capabilities, new products and new markets. This cannot be done without implementing an adapt higher education system that will lead to this quality of life. The terms ‘education’ and ‘life’ should be interchangeable as higher education is a central aspiration in achieving socioeconomic growth and success. Learning is the acquisition of knowledge or skills. Education is transferring of knowledge, attitude, and skills; therefore, education is life. One must understand the interchangeability of life and learning as instrumental in making higher education a central aspiration. This is especially true for students studying MNT, which will directly reflect the efforts of implementing and applying MNT.

Keywords: MEMS/NEMS Technology; Higher-education; Pragmatic; Prosperity; Biosensors

INVITED SPEAKERS

Id-080

Boron-Doped Diamond-Based Electrochemical Sensors in Drug and Food Analysis

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Abstract: Nowadays, electrochemical (EC) methods have attracted more attention due to cheap instrumentation, fast response and simple operation. Despite the impressive efforts and advances in the field of EC sensors, the application prospects to perform fast and reliable analysis in real systems have not been completely fulfilled and there are still many open challenges to be faced. An open key point is represented by the search and development of advanced materials suitable for EC sensors able to furnish reliable and reproducible signals with high sensitivity and low detection limits (LOD). Various conventional materials such as graphite, glassy carbon and carbon paste have been employed as EC sensors in last decades, however, with some drawbacks such as low resistance to fouling and tedious electrode cleaning. Hence, electrochemists are pushed to explore the novel and perspective material platforms as fool-proof EC sensors. Particularly, boron-doped diamond (BDD) has received growing interest thank to its superior EC properties in comparison with conventional materials such as large potential window, low background current and exceptional resistance to fouling. These properties make BDD the ideal platform to be applied as an advanced and environmental-friendly EC sensor, even without any surface modification. Herein, the fundamental objective of the authors is to introduce EC sensors based on BDD electrodes within extraordinary analytical protocols capable of simple, fast and proper biomedical and food application. Therefore, a variety of analytical methodologies and protocols based on the usage of BDD platforms will be demonstrated with emphasis on analytical performance of the sensors and methods validation. The results of this study could provide invaluable services to clinicians in diagnosis of certain diseases and to analysts in food control analysis as well as to nanotechnologists and material engineers in the design of EC sensors. Finally, the research outputs could stimulate scientific investigation in various disciplines from Material Chemistry to Analytical Chemistry and Medicinal Chemistry.

Keywords: EC sensors, glassy carbon, graphite, boron-doped diamond

Acknowledgement: This work was supported by the Grant Agency of the Slovak Republic (grant No. 1/0489/16).

INVITED SPEAKERS

Id-083

Intelligent Thermo-Sensitive Hydrogels for Biomedical Applications

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Abstract: Intelligent hydrogels have become important class of polymers and their applications have expanded significantly. This class of stimuli-sensitive hydrogels with various chemical and structural part shows responsiveness to external stimuli such as temperature, pH, surfactants, pressure, light, biomolecules, ionic strength, magnetic and electrical fields. Intelligent hydrogels, as the swellable polymeric materials, have been extensively investigated and are continuously getting increasing attention in many biomedical and pharmaceutical applications, especially in the fields of controlled and self-regulated drug delivery. Hydrogels can be neutral or ionic based on the nature of the side groups. Depending on the physical structure of the networks they can be amorphous, semi crystalline, hydrogen-bonded structures, supermolecular structures and hydrocolloid aggregates. Their behavior to adapt structural changes in response to various physical or chemical stimuli, makes them intelligent candidates for modulated/controlled release of pharmaceuticals. Developments of different intelligent hydrogels including their synthesis, characterisations and applications will be discussed. This presentation will focus on synthesized thermo-sensitive hydrogels, their properties and potential applications for the modified release of drugs. The objective of this work is the procedure of the synthesis of thermo-sensitive hydrogels based on N-isopropylacrylamide and 2-hydroxypropyl methacrylate. Copolymer hydrogels poly(N-isopropylacrylamide-co-2-hydroxypropyl methacrylate), p(NIPAM-HPMet), were obtained by radical polymerization using the initiator and the varied content of cross-linking agent. The amounts of residual monomers and a cross-linking agent in the synthesized hydrogels p(NIPAM-HPMet) were determined using a high-performance liquid chromatographic method (HPLC). The synthesized hydrogels were structurally characterized by Fourier-transform infrared spectroscopy (FTIR). The morphology of obtained products was investigated by scanning electron microscopy (SEM), the identification of phase transitions by differential scanning calorimetry (DSC) and the determination of crystal and molecular structures by X-ray diffraction (XRD). The swelling kinetics hydrogels depending on the temperature and pH-value was analyzed. Mathematical model of the swelling process and the swelling reaction order were determined. Also, the potential application of the synthesized hydrogels as drug carriers was investigated in vitro with the goal of the modified release depending on the temperature and pH change. As a model substance, different non-steroidal anti-inflammatory drugs (paracetamol, ibuprofen, phenacetin, naproxen and piroxicam) were embedded in the p(NIPAM-HPMet) hydrogels. The content of the released model drugs from these hydrogels was investigated qualitatively and quantitatively by HPLC. The interaction between hydrogel carriers and the model drugs is thought to

occur primarily via hydrogen bonding. Based on these analyses, a possible application of p(NIPAM-HPMet) hydrogel as a carrier for the modified drug release was determined. The obtained results and their significance provide possibility to use this type of hydrogels as promising candidates for preparation of suitable drug carriers.

Keywords: Thermo-sensitive hydrogels, Synthesis, Hydrogel swelling, N-isopropylacrylamide, Modified/controlled drug release.

Acknowledgement: This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (project TR-34012 “Plant and synthetic bioactive products of new generation”).

INVITED SPEAKERS

Id-084

Functionalized Polyurethane Foams and Biomimetic Composites for Tissue Engineering

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Abstract: In the last 20 years, our research group investigated the design of polyurethane (PU) foams suitable for use as scaffolds in Tissue Engineering, acquiring a strong know-how on this line of research [1-3]. PU foams are obtained by a one-step synthesis procedure, using water as expanding agent, a purposely assembled polyol mixture, Fe-Acetylacetonate as reaction catalyst and polymeric MDI (Desmodur PF, Bayer) as isocyanate. Cytocompatible foams, with pores of 300-500 μm average size and 80-90% open-pore structures. a) PU foams as 3D model for breast cancer (BC) In vitro 3D models gained great interest in cancer research, thanks to reproducibility, 3D spatial cues and associated low costs, compared to in vivo and 2D in vitro models. The suitability of a poly-ether-urethane foam as 3D in vitro model was successfully investigated to study the interactions between BC tumor-initiating cells and the bone microenvironment [4]. b) Functionalization to promote interactions with cells Recent advancements in Tissue Engineering ask for the development of tailored scaffolds with physicochemical cues able to promote specific and positive responses on cells of the target tissue. For this purpose, functionalization of PU foams with a molecule (i.e., the amino-amide diol PIME [5]) predictably able to provide the foams with improved hemo- and cyto-compatibility and resistance to bacterial colonization. Preliminary results indicated that, in addition to the favourable morphology of the PU foam, the presence of PIME may increase the cytocompatibility of the scaffold, in the absence of external factors. c) Biomimetic composites for bone regeneration Biocompatible composites with calcium phosphates were developed and tested for bone regeneration. Biomineralization of the PU foams, carried out by activation of the PU surface with a two steps procedure, led to a significant increase of mechanical properties and provided a more suitable surface for rat BMSCs attachment and proliferation [6].

Keywords: Polyurethane, foams, scaffolds, biomimetic composites, cell interactions

References

[1]. M.C. Tanzi et Al., J. Appl. Biomater. Biomech. 2003, 1, 58

[2]. M. Zanetta, et Al., Acta Biomaterialia, 2009, 5,1126

[3]. S. Bertoldi, et Al., J. Mater. Sci: Mater. Med., 2010, 21, 1005

[4]. V. Angeloni et Al., Acta Biomaterialia 2017, 63, 306-316; [5] M. C. Tanzi, EP0870766B1 Patent, 1997, and US Patent 6143893, 1999; [6] M. Meskinfam et Al., Materials Science and Engineering C, 2018, 82, 130.

INVITED SPEAKERS

Id-086

Fabrication and Development of Microelectrodes for Label-Free Biosensing.

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Abstract: With the electroanalytical advantages of reduced *iR* drop, improved signal to noise, relative insensitivity to convection and steady state currents, microelectrodes represent an exciting candidate technology for the development of biosensors. One particular attraction is the ability to fabricate arrays of microelectrodes for the detection of multiple analytes. This is particularly advantageous for the diagnosis and monitoring of complex medical conditions such as sepsis, drug resistant infections and oncogenic mutations (all of which are conditions we develop sensors for in the group). Problems with the development of microelectrodes for biosensing, particularly those utilising electrochemical impedance (EIS) spectroscopy as a label free, non-destructive measurement of target-analyte binding have included: interpretation of the more complex EIS response associated with a microelectrode and developing reproducible surface functionalisation chemistries to allow stable baseline measurements before addition of the target molecule. This talk will initially focus on the fabrication of the multi-microelectrode arrays we use for biosensing applications. Emphasis will then shift to the development of measurements of DNA-DNA hybridisation for MRSA using microelectrodes and identifying the necessary conditions and electrode choice to successfully record the impedimetric response upon target binding. It will also give consideration to the chemical modifications necessary to successfully and reproducibly form self-assembled monolayers (SAMs) composed of chemically and biologically responsive sensing elements. Finally, the talk will show a newly fabricated array of microelectrode sensors on a needle shaped substrate which have been shown capable of detecting a common inflammatory biomarker of sepsis (Interleukin-6) at clinically relevant levels in near real time.

Keywords: Microelectrodes; electrochemical biosensors; impedance; self assembled monolayers

INVITED SPEAKERS

Id-088

The Application of Polyhydroxyalkanoates in Medicine: Biomimetic Aspects

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Abstract: Biodegradable and biocompatible polymers, polyhydroxyalkanoates (PHAs), are widely used in medicine for production of a wide range of medical devices (screws and plates for bone fixation, bowel patches and plugs, cardiovascular stents, wound coverings, nerve guidance conduits, surgical meshes etc.) and dosage formulations for sustained and targeted drug delivery. PHAs can be used also in bioengineering, e.g. for tissue engineering, as scaffolds for cell factories, for developing experimental disease models in vitro, e.g. 3D tumor growth model. The medical and pharmaceutical industry applies mainly PHAs that obtained by chemical synthesis, but the interest in the medical use of natural PHAs obtained biotechnologically is also growing. Synthetic PHAs are biomimetic analogs of bacterial poly(3-hydroxybutyrate) (PHB) and other natural PHAs. We developed an effective precursor feeding technology of PHB and its copolymers production using bacterial strain-producers from genus Azotobacter, which allow to synthesize various PHAs with desired properties and studied physicochemical and biological properties of obtained biopolymers. The main biomedical properties of PHB and other natural PHAs: biodegradability, biocompatibility, and bioactivity are directly related to the various functions of these biopolymers in nature, e.g. their physiological role in the bacterial cell. The possibility of biosynthesis and biodegradation of PHB by different symbiotic and infectious human and animal bacteria, particularly, multiple bacteria of intestinal microbiota is therefore particularly interesting. There is still a lot of obscure in the problem of endogenous PHB in human and animal tissues: can the microbiota bacteria be a source of endogenous PHB? Thus, the biological functions of PHB and other natural PHAs in bacteria and eukaryotes, including human, are, apparently, the most important reason for using both natural and synthetic PHAs in medicine and pharmacy.

Keywords: Polyhydroxyalkanoates; Poly(3-Hydroxybutyrate); Azotobacter chroococcum; Biodegradation; Biocompatibility; Biomimetics; Microbiota; Endogenous.

Acknowledgements: This work was supported by Russian Foundation of Basic Research, Project # 18-29-09099.

INVITED SPEAKERS

Id-090

The Enhancement of Morphogenesis Using Surface-Immobilized Hyaluronic Acid-Catechol

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Abstract: Epithelial organ development undergoes unique developmental process called branching morphogenesis (BM). We developed highly efficient and biocompatible hyaluronic acid-catechol (HACA) coating system to enhance in vitro BM up to in vivo-level BM in salivary glands. HACA was synthesized and completely oxidized within 12 hrs. Then HACA was evenly coated on PC membrane. Embryonic submandibular glands (eSMGs) cultured on HACA membrane showed enhanced BM; increased bud number, bud/duct ratio, vascular endothelial (VE) and parasympathetic ganglion (PSG), and c-kit+ progenitor cell proliferation. Ki-67 staining also indicated that eSMGs cultured on HACA coated membrane showed significantly increased proliferation rate. Enhancement of BM by HACA coating was due to the CD44 receptor clustering on the mesenchyme cells. BM was ceased when eSMGs were cultured on stiff agarose hydrogel, but with HACA coating VE and c-kit+ progenitor cell proliferations were partially restored. Finally, HACA coated 3D-printed PCL scaffolds resulted improved BM by eliminating PCL scaffolds' negative properties such as stiffness, hydrophobicity, and deleterious surface topology. In conclusion these results suggest that HACA is easy and reproducible biocompatible coating system that helps conventional biomaterials to mimic in-vivo conditions. Therefore, HACA coating system will be useful on various surfaces, scaffolds, and even on tissue for the regeneration of epithelial tissues.

Keywords: Branching morphogenesis, hyaluronic acid-catechol, epithelial tissues

Acknowledgements: This work was supported by a National Research Foundation of Korea grant (NRF-2018R1A2B3005113) at Seoul National University

INVITED SPEAKERS

Id-092

Electrically Responsive Biomaterials as Potential Drug Delivery Systems

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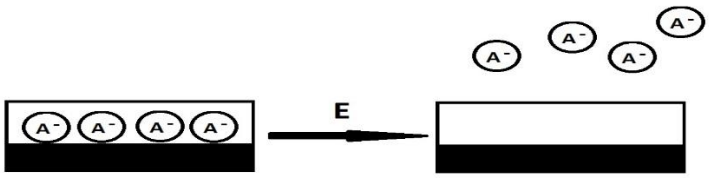
Abstract: Controlled drug delivery systems have become increasingly important and have progressed over the last six decades, due to potential advantages in safety, efficacy and patient convenience that these long-acting systems provide. However, there are a number of factors to be considered when developing such systems, including biocompatibility (or the possible toxicity of the materials used), and any requirements for surgical implantation/removal of the system when compared with traditional pharmaceutical formulations (delivered via creams, injections, orally). Manufacturing implantable medical devices with minimal immune system response and the potential to release drugs from the implant in a controlled manner are key industrial challenges. Engineering stimuli-responsive smart implants that enable the delivery of predetermined amounts of drugs at specific locations and times may counter common clinical problems (e.g. inflammation, microbial infection) post device implantation. Conductive polymers can provide controlled release of drugs in response to electrical stimuli. Among conducting polymers polyaniline, polythiophene, poly(3,4-ethylenedioxythiophene) and polypyrrole have been used for drug release [1-3]. In this study, different forms of electroactive polymers were prepared, characterised with a variety of techniques (microscopy, spectroscopy, electrochemistry etc.) and drug release studies were conducted [4-6].



Scheme 1. Illustration of drug release from electroactive polymer coatings. Black) conductive substrate (e.g. ITO, metal). White) Cationic electroactive polymer (e.g. Polypyrrole). A^-) Anionic dopant.

Keywords: Electroactive polymers, drug delivery, medical devices

References

[1]. Guimard, N. K.; Gomez, N.; Schmidt, C. E. Conducting polymers in biomedical engineering. Prog. Polym. Sci., 2007, 32 (8-9), 876.

[2]. Guiseppi-Elie, A. Electroconductive hydrogels: Synthesis, characterization and biomedical applications. Biomaterials 2010, 31(10), 2701.

[3]. Krukiewicz, K.; Kruk, A.; Turczyn, R. Evaluation of drug loading capacity and release characteristics of PEDOT/naproxen system: Effect of doping ions. Electrochimica Acta, 2018, 289, 218.

[4]. Shah, S. A. A.; Firlak, M.; Berrow, R. S.; Halcovitch, N. R.; Baldock, S. J.; Yousafzai, B. M.; Hathout, R. M.; Hardy J. G. Electrochemically Enhanced Drug Delivery Using Polypyrrole Films. Materials, 2018, 11, 1123.

[5]. Au-Yong, S.; Firlak, M.; Draper, E. R.; Baldock, S. J.; Halcovitch, N. R. ; Hardy, J. G. Electrochemically enhanced drug delivery from electroactive hydrogels, European Polymer Journal (submitted).

[6]. Firlak, M.; Lee, L.; Baldock, S. J.; Hardy J.G. Electrochemically enhanced delivery of pemetrexed from polypyrrole films. (in preparation).

INVITED SPEAKERS

Id-093

A Glass-Based Adhesive for Skeletal Fixation and Stabilization

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Abstract: Between 2000 and 2050, the population aged 85 and over, the group most likely to need health and long-term care services, is projected to increase by 350% [1]. This will necessitate healthcare being focused toward chronic diseases, such as heart disease and osteoporosis, rather than acute illnesses [1]. Osteoporosis is a condition characterized by low bone mass and an increased risk of fracture. In 2008, there were 4.9M fragility fractures in the US alone; the cost of osteoporosis to healthcare providers being recorded as $22B [2]. Considering fragility fractures of the wrist, surgery may be necessary when the position of the broken bone is displaced [3]. A review of techniques including internal, external and percutaneous fixation using one, or a combination, of pins, plates, screws, casts or stabilizing frames was recently published by the presenter [4]. Bioadhesives have limited applicability in wrist fixation and stabilization as those cements based on methyl methacrylates do not chemically bond to bone and those based on calcium phosphates have little strength in tension, indicating that new materials are required for improved prognosis.

This presentation will discuss a new adhesive for fracture fixation and stabilization which is being evaluated in both fracture fixation and sternal stabilization. The adhesive is based on glass polyalkenoate chemistry and has been adapted from the dental field and patented through the presenter's laboratory.

Keywords: Bioglass, fracture fixation, antibacterial testing

References

[1]. Wiener JM & Tilly J. Int J Epidemiol (2002) 31 (4): 776-781.

[2]. Singer et al., Mayo Clinic Proceedings, 2015.

[3]. http://www.uwmedicine.org/health-library/Pages/wrist-fractures.aspx

[4]. B.A. Khader & M.R. Towler. *Materials Science and Engineering C* (accepted, 2016)

INVITED SPEAKERS

Id-095

Microfluidic Generation and Applications of Water-In-Water Droplets

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Abstract: A water-in-water system, aqueous two-phase system (ATPS), is formed when two incompatible polymers, such as polyethylene glycol and dextran, are mixed in water and phase-separated above a critical polymer concentration.[1] Because of its biocompatible nature, it has been used in many different biomedical applications. Recently, ATPS has been highlighted in microfluidic device applications, and already demonstrates the benefits in separating cells and protein, encapsulating cells and in biomolecule delivery. However, due to the ultralow interfacial tension of ATPS (typically γ = 0.1-100 μN m^{-1}), most ATPS microfluidic experiments have been limited to the manipulation of simple laminar flows. The ultralow interfacial tension of ATPS makes drop breakup in microchannels by the classical Rayleigh–Plateau instability difficult to achieve. Here, I will present a microfluidic ATPS droplet formation system that utilizes a pulsating applied pressure, and hydrodynamic flow focusing.[2] The on–off pressure cycles of the disperse DEX phase, in combination with the constant flow rate continuous PEG phase, make it possible to controllably produce monodisperse ATPS droplets in a flow focusing junction. Not only this active ATPS droplet formation method but also I will introduce a simple microfluidic technique that generates ATPS droplets by passive flow focusing.[3] This method combines a classical microfluidic flow focusing geometry with precisely controlled pressures. With this passive droplet formation approach, I will demonstrate the applications of the dynamic control of ATPS droplets in shrinking, growing, and dissolving conditions.[4] Furthermore, this unique technique is applied to controllably release encapsulated microparticles and cells. This approach may find utility in many biomedical settings, for example, in drug and cell delivery and release applications.

Keywords: Aqueous two-phase system (ATPS), Droplet microfluidics, Phase separation

References

[1]. Walter, H.; Johansson, G. Methods in Enzymology; Academic Press: New York, 1994; Vol. 228.

[2]. B.-U. Moon, S. G. Jones, D. K. Hwang, S. S. H. Tsai, Lab Chip, 2015, 15, 2437–2444.

[3]. B.-U. Moon, N. Abbasi, S. G. Jones, D. K. Hwang, S. S. H. Tsai, Anal. Chem., 2016, 88, 3982–3989.

[4]. B.-U. Moon, D. K. Hwang, S. S. H. Tsai, Lab Chip, 2016, 16, 2601-2608.

INVITED SPEAKERS

Id-097

Cationic Polymer Surfaces with Antibacterial Properties for The Immunohematological Control of Blood

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Abstract: Bacterial contamination is the main problem associated with the collection, storage, transportation and use of blood and its sub-products. Bacteremia is mainly caused by the contamination of catheters and other intravascular instruments used in different medical procedures [1]. Currently, control protocols and photosensitizing agents in order to avoid the bacterial contamination of blood; however, the use of these methods under non-optimal conditions turns out inefficient. But also, the activation of these photosensitizers produces sub-products that can enter in blood stream during blood transfusion and, due to their non-selectivity, these substances attack the cellular systems of the patient representing a toxicological risk of carcinogenicity, mutagenicity and chromosomal aberrations [2]. On the other hand, the antimicrobial activity of various compounds with cationic ammonium and phosphonium groups has been reported and evaluated in different low molecular weight systems. Its mechanism of action is associated with the disruption of the bacterial cell wall by the electrostatic interaction of the cationic centers with the negatively charged groups present on the surface of the microorganism [3]. In particular, our research group is interested in the development of cationic polymer surfaces, with ammonium quaternary groups on their structure, as a strategy for obtaining of novel materials with antibacterial properties for potential applications in the immune-hematological control of blood and hemoderivates. For this, the synthesis of cationic-PVC was carried out by the modification of PVC with ethylenediamine for the incorporation of amino groups in the polymeric matrix and subsequent formation of the ammonium quaternary groups through the exhaustive ethylation with 1-bromoethane of the free amino groups. On the other hand, *N*-(carboxymethyl)-*N,N,N*-triethylammonium chloride, CMTEA, was synthesized through the reaction of ethyl bromoacetate with triethylamine and subsequent hydrolysis with 12 mol/L HCl. Later, cationic-PUs were synthesized in solid phase, from the CMTEA, 4,4'-diphenylmethane diisocyanate and mannitol using different molar ratios between them. Finally, the materials obtained were characterized by elemental analysis, nuclear magnetic resonance, thermal analysis and infrared spectroscopy. In addition, surface properties, antibacterial and hemocompatibility properties were studied. It was concluded that by the proposed methodology is possible to obtain cationic polymers with antimicrobial properties based on PVC and PUs, these systems showed adequate thermal stability and hemocompatibility suggesting that can be used in potential immune-hematological applications.

Keywords: Polymer surfaces, antibacterial, blood, bacteremia

Acknowledgements: Financial Support: Mindtech s.a.s. and Universidad del Valle

References

[1]. TVSP Murthy. Indian J Anaesth. 2014;58(5):643–646

[2]. M Schmidt, *et al*. Transfusion. 2015;55(9):2104–2112

[3]. K Minbiole, *et al*. Tetrahedron. 2016;72(25):3556-3566

INVITED SPEAKERS

Id-099

Highly Sensitive Surface Plasmon Resonance Biosensor Modified with Halloysite Nanotubes

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Abstract: We propose and demonstrate a novel strategy to modify the plasmonic interface by using a thin layer of Halloysite nanotubes (HNTs). The modified surface plasmon resonance (SPR) sensor achieves a great improved sensitivity, because the large surface area and high refractive index of the HNTs layer significantly increases the probing electric field intensity and hence the measurement sensitivity. More significantly, the thickness of HNTs layer can be tailored by spraying different concentrations of HNTs ethanol suspension. Experimental results suggest that the highest sensitivity achieved at the 7.5% concentration of HNTs suspension is up to 10431 nm/RIU, an enhancement of 5.6 fold when compared to that of the conventional gold based substrates. An even higher sensitivity of the HNTs-SPR sensor can be achieved by the Au-Graphene sensor. Additionally, the proposed approach is a chemical-free and environment-friendly modification method for the sensor interface, without additional chemical or biological amplification steps (no toxic solvents are used). These unique features make the proposed HNTs-SPR biosensor a simple, biocompatible, and low-cost platform for trace level detection of biochemical species with a rapid, sensitive and non-destructive manner.

Keywords: Surface plasmon resonance; Interface; Halloysite Nanotubes; Sensitivity.

INVITED SPEAKERS

Id-100

Methodologies for Long-Term Performance Evaluation of Bioresorbable Polymers used in Bone Fixation and Tissue Scaffolds

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Abstract: Implants made from bioresorbable polymers are gaining significant interest in orthopaedic, sports-injury and cardiovascular markets. The advantage of such materials over permanent metallic implants is that they provide temporary support during healing, then gradually degrade, transferring mechanical loads to regenerating tissue. They are also utilised in drug and bioactive release systems owing to the ability to tailor their bioresorption rate via appropriate polymer selection and post-processing procedures. Furthermore, they have potential for application in patient-specific tissue scaffolds produced by layer-by-layer manufacturing techniques such as fused deposition modelling. This presentation will review manufacturing considerations for the fabrication of bioresorbable implants, focusing on melt-processing and tissue scaffold production via fused deposition modelling, for the bioresorbable polymer, poly (lactic-co-glycolic) acid (PLGA). Typical degradation behaviour and bioactive release mechanisms will be reviewed for these clinically relevant bioresorbable polymers containing bioactive fillers such as calcium phosphate (beta-TCP) and silica diatoms (*Cyclotella meneghiniana*). The benefits of *in vitro* accelerated degradation testing will be presented along with some of the challenges of evaluating degradable systems *in vivo*. This will consider the delayed inflammatory response which has been report in some clinical studies in the late stages of polymer degradation. Few studies have assessed the long-term biocompatibility of these polymers and with an increasing market for bioresorbable materials it is anticipated that this will be an increasing issue. We aim to develop a predictive tool that can be used to assess the delayed inflammatory response of poly(D,L-lactide-co-glycolide) (PDLGA) using *in vitro* tests. An elevated temperature accelerated test (47°C) was developed and utilised to induce predetermined amounts of degradation in PDLGA. This was used to mimic a range of clinically relevant *in vivo* implantation times up to three months. All pre-degradation work was performed under sterile conditions, in PBS solution. At predetermined time intervals, indicators of late stage inflammation will be assessed using an MTT cytotoxicity assay, an inflammation antibody array and an ELISA analysis for inflammatory factors, with mouse L929 fibroblasts. It is hypothesised that at the later degradation time intervals signs of inflammatory factors will be observed. The benefits of the methodologies developed in this work is that they may be applied to the optimisation of polymer degradation profiles to minimise late-stage inflammatory response and identification of post-processing treatments and additives in this regard.

Keywords: Bioresorbable polymer, degradation, PLGA, tissue scaffold, inflammatory respopnse

INVITED SPEAKERS

Id-101

Soil-on-a-Chip: Exploring Microbial Interactions at The Cellular Level Using Microfluidic Technology

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Abstract: Soil is one of the most complex systems on Earth, governed by numerous physical, geochemical and biological processes, and provides the ecosystem services vital for terrestrial life. This 'material' supports a myriad of plants, microorganisms and microfauna and hosts a complex array of interactions taking place between these living elements. However, despite the importance of microbes in soil functioning, there exists a major knowledge gap concerning the function and dynamics of the soil microbiome and influence of the physio-chemical environment upon microbial interaction and communication at the cellular level. Recently, it has been demonstrated that microfluidic technology offers several new opportunities to study whole living organisms and their interactions. Microfluidics is defined as the science and technology of fabricated systems used to manipulate fluids on the micron scale and has a great potential to provide a unique view of biological events at the level of single organisms and cells (i.e. microbe–microbe interactions), allowing precise environmental control, high-resolution imaging and the simulation of environmental complexity. I have developed several microfluidic systems to probe the interactions between fungi, bacteria and nematodes, which has revealed novel insights into the antagonistic strategies of these microorganisms including bacteria-induced blebbing of hyphal cells and a dynamic polar attachment of *B. subtilis* cells to a specific subset of *C. cinerea*, as well as discovering that undifferentiated mycelium can communicate within certain microdomains using previously unknown specialised hyphae. I recently developed the dual-flow-RootChip that allows investigations on the interaction of plant roots with their environment under simulated environmental heterogeneity, revealing that external asymmetry can result in internal asymmetry at the physiological and genetic level. We are now developing new tools to enhance our understanding of microbial interactions in the rhizosphere, specifically by using microfluidic technology to probe the cell biology and physiology of microbe association and colonisation of arbuscular mycorrhizal fungi at the cellular level.

Keywords: Microfluidics; Microbe-microbe interactions; Plant-microbe interactions; Single cell; Arbuscular mycorrhizal fungi; Organ-on-a-chip

INVITED SPEAKERS

Id-102

Protein-based Nanoparticles for Delivery of Active Molecules

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Abstract: Self-assembling protein subunits that form hollow cage-like structures have, called protein cages, been investigated as potential molecular carriers. However, tuning the release rate of encapsulated molecules from these protein cages is a challenge. We hypothesize that by rationally modulating the protein-protein interactions between the protein cage subunits, the release of molecular cargo from the lumen can be tuned. To test the hypothesis, we introduced modifications at the intersubunit interface and the interaction surfaces between two molecules by introducing non-native histidines or substituting the interacting surfaces with other peptide sequences. The effects of the modifications were characterized for pH responsiveness. In recent studies, we also found that these protein cages form an ensemble that stabilize oil droplets in water by localizing at the oil-water interface and forming Pickering emulsion. However, their behaviour and structural integrity at this interface is rarely studied. In this work, we present a model protein cage derived from the E2 protein of Geobacillus stearothermophilus and show their pH-responsiveness as individual molecules as well as the resulting emulsion that is formed by their ensemble. The pH responsiveness is relevant for the triggered release and delivery of active molecules encapsulated at specific sites of the body (e.g. endosomes, skin). Another interesting observation is that the protein cages retain their structural integrity at the oil-water interface forming protein ensemble. This behaviour is distinct from other small (monomeric/ dimeric) proteins and shed a new light for further studies of protein assemblies at interfaces.

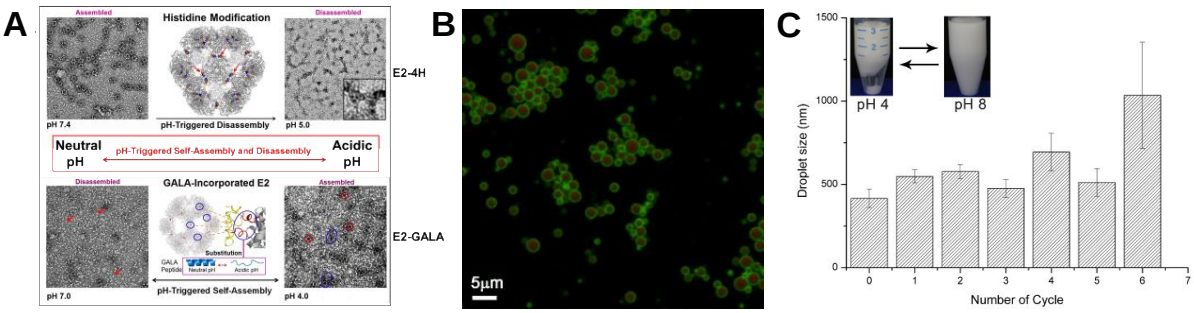

Fig. 1: (A) E2 protein cage (~25 nm diameter) modified at the inter-subunit interfaces that result in pH-responsiveness of individual protein cages; (B) Confocal micrograph of E2 protein cage assemblies at oil-water interface (red=rosemary oil; green=protein cages) forming Pickering emulsion; (C) pH-responsiveness of the Pickering emulsion is reversible.

Keywords: Protein nanocage, protein engineering, nanoparticle, biosurfactant, emulsion

References

[1]. M Dalmau, S Lim, SW Wang (2008) Nano Lett **9**(1):160-166

[2]. T Peng, S Lim (2011) Biomacromolecules **12**(19):3131-3138

[3]. B Sana, E Johnson, S Lim (2015) BBA General subjects 1850 (12):2544-2551

[4]. M Sarker, N Tomczak, S Lim (2017) ACS Appl Mater Interfaces 9(12):11193–11201

[5]. S Bhaskar, S Lim (2017) NPG Asia Mater 9(4): e371

[6]. K Yu, YH Yau, A Sinha, et al. (2017) Sci Rep 7(1):14816.

INVITED SPEAKERS

Id-111

Fabrication of Multifunctional Nano and Micro Size Biopolymer Particles

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Abstract: The synthesis of hemoglobin particles (HbMP-700) is based on a CCD-technique, C: co-precipitation of hemoglobin (Hb) with $MnCO_3$ immediately followed by addition of human serum albumin (HSA), C: cross-linking of Hb and D: dissolution of the $MnCO_3$ template resulting in polymerized submicron HbMP-700 with an average size of around 710 ± 60 nm [1]. The steps coprecipitation and cross-linking of hemoglobin (Hb) can be combined in one single step since the cross-linker, periodate-oxidized dextran, is incorporated into the inorganic template, MnCO3, together with the protein. After removal of the MnCO3 templates by EDTA, the amount of entrapped Hb was 60 to 70% of the initial amount [2, 3]. These HbMP-700 possess a high oxygen affinity (*p*50 of 6-15 mmHg) compared to 26.5 mmHg of Hb in solution and does not scavenge NO, which are important properties of the new generation of HBOCs. [4, 5] The HbMP-700 can be loaded with hydrophobic or hydrophilic nanoparticles (NPs) or with superparamagnetic NPs (e.g. SPIONs) during or after the precipitation. Since HbMP-700 are not recognized by phagocytizing cells they can fulfill several functions – they delivery oxygen to the tissue with low pO_2, can release slowly the immobilized NPs or enzymes and can be detected by MRI if SPIONs are incorporated. Surface modifications with antibodies or peptides allows the HbMP-700 to target endothelia cells, circulating tumor cells, monocytes, granulocytes and others. The HbMP-700 are endocytosed/phagocytized, accumulated in the targeted tissue and release their content into the cells. Due to the combination of oxygen and drug delivery with contrast enhancing particles the HbMP-700 could serve also as THERANOSTICS.

Keywords: Artificial oxygen carriers; Co-precipitation; Composite materials; Hemoglobin; Nanoparticles; Oxygen affinity.

References

[1]. Xiong, Y. et al. ACS Nano 7(9), 7454–7461, 2013

[2]. Kloypan, C. et al. J Artificial Cells, Nanomedicine and Biotechnology (2018) DOI: 10.1080/21691401.2018.1521819

[3]. Kloypan, C. et al. J Artificial Cells, Nanomedicine and Biotechnology (2018) (accepted)

[4]. Bäumler, H. et al. Artificial Organs 38(8), 708–714, 2014

[5]. Bäumler, H. & Georgieva R. Biomacromolecules 11, 1480–1487, 2010

INVITED SPEAKERS

Id-112

Biosensors Based on Gradient Guided-Mode Resonance Filter

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Abstract: With the coming era of Internet of Medical Things (IoMT), several research groups integrated an optical biosensor with a smartphone. However, in order to obtain spectral information, often time, external gratings or prisms are needed, which complicated the design and resulted in a bulky attachment. To overcome this, we proposed gradient guided-mode resonance (GMR) biosensors, which converts the spectral information into spatial information; therefore, allowing direct readout from smartphone CCD or CMOS camera. A basic structure of a GMR filter consists of subwavelength grating structure with a waveguiding layer. In this talk, we will present two different gradient GMRs. In 2016, we first developed a GMR with gradient grating period (GGP), which we termed as GGP-GMR. On the other hand, with a custom-made fixture and sputtering process, we fabricated a GMR with gradient waveguide thickness (GWT), which is called as GWT-GMR. For both gradient GMRs, simulation models based on DiffractMOD from RSoft were built, and the theoretical performances can be evaluated in terms of sensitivity and limit of detection (LOD). A series of sucrose solutions of different concentrations was used to characterize the sensitivity and LOD for both gradient GMR sensors. Bulk sensitivities for GGP-GMR and GWT-GMR on the order of 10-3 and 10-4 RIU were achieved. In addition, two different types of bio entities were used as models to demonstrate the capability of practical biosensing applications. For the GGP-GMR biosensor, the detection of E coli with LOD on the order of 100 CFU/mL can be achieved, which is comparable to that obtained by PCR. On the other hand, for GWT-GMR, the detection of antibody can achieve LOD on the order of ng/ml, which is sufficient for many practical applications. The readout system requires a narrow band of light and a simple CCD combined with the compact design of the GGP-GMR or GWT-GMR sensors, which eases the miniaturization of the system for handheld devices as well as its integration with smartphones.

Keywords: Guided-mode resonance; Subwavelength structure; Bandstop filter; Grating.

INVITED SPEAKERS

Id-114

Amyloids as Biomineralizing Tools

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Abstract: BACKGROUND**:** Design and production of materials to suffice the world demands with an eco-friendly view is essential for the construction of a sustainable planet. Bioinspiration provides a uniquely safe strategy, putting synthetic biology at a leadership position. Of the distinct biocomposites, calcium carbonate biominerals forming balancing systems and shells are the most abundant. In these biominerals, the nucleation, growth and morphology of carbonate crystals are modulated by acid proteins. These proteins also share oligomerization propensity involving extended β-strand structures, suggesting that amyloid assemblies with acidic regions could modulate calcium carbonate crystallization.

OBJECTIVE**:** To test whether amyloid folds of biocomposite unrelated Ca^{2+}-binding proteins influence calcium carbonate crystallization in vitro.

RESULTS: Gad m1, an Atlantic cod β-parvalbumin isoform was produced recombinantly and assembled into amyloids by Ca^{2+} removal. Atomic force microscopy showed protofibrillar or rod-like nanoplatelet assemblies. After verifying their stability, the assemblies were placed in the presence of Ca^{2+} and calcium carbonate precipitation was enabled by controlled diffusion of CO_2 from the decomposition of ammonium carbonate. The representative crystal structures that formed were visualized by scanning electron microscopy. Controls for the absence of protein and presence of soluble Gad m 1 monomer yielded the common rhombohedral form of calcite crystals. In contrast, amyloids yielded cylindrical and sheaf-like calcite crystals as judged by their selected area electron diffraction patterns.

SIGNIFICANCE: These results provide a proof of concept for the functional exploitation of a non-physiological amyloid in the field of calcium carbonate-based materials.

Keywords: Biomineralization, amyloids, calcium carbonate

INVITED SPEAKERS

Id-117

Conducting Polymer Micro/Nanofibers-Based DNA sensor

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Abstract: Conducting polymer (CP) nanofibers have gained great attention due to the advantageous properties in applications such as electronic devices, scaffolds for tissue engineering and sensors. Advances in nanotechnology allow for the fabrication of various conducting polymer in nanomaterials form through synthesis methods and top down approach such as electrospinning. Nanostructured conducting polymers featuring high surface area per volume, small dimensions, and unique physical properties have been widely used to build various sensor devices. The presentation will be discussed preparation, characterization of conducting polymer micro/nanofibers prepared by using electrospinning and chemical synthesis method. Two types of conducting polymers, polyaniline (PANI) and poly(6,6'-((2-methyl-5-((E)-4-((E)-prop-1-en-1-yl)styryl)-1,4-phenylene)bis(oxy))dihexanoic acid) based nanofibers were used in this study. Both of the CP nanofibers were used to investigate their potential in DNA sensing application.

Keywords: Conducting polymers; Polyaniline; PDMP; Nanofibers; DNA Sensor.

INVITED SPEAKERS

Id-122

Bioelectronic Tongue Based on Electrochemical Sensors. Applications in The Food Industry

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Abstract: In the last years new methods for the analysis of complex liquids -the so-called electronic tongues- have been developed. They consist in arrays of sensors (usually electrochemical sensors) coupled to a pattern recognition software [1]. E-tongues analyze the sample as a whole without need of separating it in simple components. The objective of our work is to develop a bioelectronic tongue dedicated to the analysis of wines and grapes. For this purpose, arrays of sensors formed by phthalocyanines combined with biosensors (containing enzymes such as glucose oxidase or tyrosinase and phthalocyanines as electron mediators), have been developed. Sensors are tested individually towards model solutions of antioxidants or sugars usually present in wines and grapes. The electrochemical responses are characterized by complex curves that contain information about the pH and the content of sugars and antioxidants. The sensibility, detection limit and stability of the sensors has been evaluated. These experiments have been used to select the most appropriate sensors to construct the array. The final array of sensors has been used to analyze red wines and red grapes of five different varieties (From de D.O. Ribera de Duero. Spain). The sensor array coupled with pattern recognition techniques is able to distinguish the red wines and red grapes on account of their chemical nature.

Keywords: Electronic tongue; biosensor

Acknowledgements: Financial support by MINECO-FEDER (AGL2015-67482-R and CTQ2017-87102-R) and the Junta de Castilla y Leon and FEDER (VA275P18) is gratefully acknowledged.

References

[1]. M.L. Rodríguez-Méndez, Electronic Noses and Tongues in Food Science, Elsevier (2016)

INVITED SPEAKERS

Id-127

Emerging Nanoscale Membrane Mimetics for Research and Biosensing

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Abstract: Lipid bilayers and lipid-associated proteins play crucial roles in biology. As *in vivo* studies and manipulation are inherently difficult, membrane-mimetic systems are useful for the investigation of lipidic phases, lipid-protein interactions, membrane protein function and membrane structure *in vitro*. In recent years, progress has been made in designing and characterizing nanoscale lipid bilayers whose circumference is stabilized by proteins, peptides, synthetic polymers, or most recently by double-stranded DNA. These discoidal nano-objects are typically 15-30 nm wide and thus attractive for single molecule studies on membrane proteins or membrane-associated proteins but also for structural studies using cryo-EM. The presentation covers the synthesis and self-assembly of such nanoparticles, their application in molecular biophysics of membrane proteins. Based on the most recent development of the field, an outlook will be given that emphasizes the yet unexplored potential of DNA-encircled bilayers for novel biosensing and pharmacological applications.

Keywords: Nanodiscs, lipid bilayer, DNA, membrane proteins, self-assembly

INVITED SPEAKERS

Id-130

Surface Cleaning And Antibacterial Properties Of Nanohybrid Thin Films Using Solar Energy Driven Photocatalyst

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Abstract: Metal oxide nanoparticles that can be excited in visible/solar light were prepared and their photoreactive properties were investigated for oxidation of hazardous organic matter. Our examinations were measured on solid -gas and solid-liquid interface. The aim of our experiment was to produce self-cleaning and reactive surfaces for use in environmental technology and health care practical applications. We focus on the light- induced photooxidation and antibacterial activity of the functionalized photocatalyst coatings. The photocatalytic efficiency of the initial metal oxide (TiO_2 and ZnO) photocatalysts can be also increased by the functionalization of catalyst nanoparticles. It is possible to extend the light absorption spectra of TiO_2 by, for example, modifying the catalyst with different non-metallic [1] and metallic elements [2-4]. For the purposes of practical application is very important to attach the photocatalyst nanoparticles to the solid surface [5]. Polymer binders are highly suitable for this application. We presented that the incorporation of photocatalyst nanoparticles in an appropriate binder or support material is expected to generate antimicrobial and self- cleaning properties, which would expand its scope of application [6]. Moreover, the adhesion properties of methicillin resistant *S. aureus* (GR+), *P. aeruginosa* (GR−) and *Escherichia coli* (E. coli) (GR−) bacteria were also investigated on the surface of photoreactive nanohybrid films. The reactive TiO_2/polymer thin films with various wetting properties from (contact angle: $0°<\theta<150°$) were also synthetized. The surface roughness and wetting properties of the two component hybrid layers were gently adjustable by the catalyst nanparticle/ polymer ratio. According to the photocatalytic measurements the layers were shown not only photoreactive but also superhydrophobic properties. This dual superhydrophobic and photoreactive coatings with selective surface wetting properties are very attractive in different applications.

Keywords: Photocatlayst, solar energy, nanohybrid materials, antibacterial properties

References

[1]. R. Kun, S. Tarján, et. al., *J. Solid State Chem*. 182 (**2009**) 3076–3084.

[2]. L. Kőrösi, Sz. Papp, et. al, *Chem. Mater*. 19 (**2007**) 4811–4819.

[3]. L. Kőrösi, A. Oszkó, et. al, *Appl. Catal. B* 77 (**2007**) 175–183.

[4]. Á. Veres, T. Rica et. al. *Catalysis Today* 181 (**2012**) 156– 162

[5]. Sz. P. Tallósy, L. Janovák et. al. *Appl. Surf. Sci.* 371 (**2016**) 139–150

[6]. Á Deák, L. Janovák et. al. *Applied Surface* Science 389 (**2016**) 294.

INVITED SPEAKERS

Id-134

All-fiber-optic VOC Gas Sensor Based on Side-polished Fiber Wavelength Selectively Coupled with Cholesteric Liquid Crystal Film

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Abstract: Volatile organic compounds (VOCs) gas causes not only pollution to the environment but also harmful effects on human. Therefore, it is very desirable to implement highly sensitive sensors to monitor VOC gas in various fields, such as chemical factory and biology. In this work, a cholesteric liquid crystal film coated side polished fiber (CLCFC-SPF) is demonstrated to sense the VOC gas. In the CLCFC-SPF, the wavelength selectively coupling from the SPF to the cholesteric liquid crystal film (CLCF) results in the resonant dips in the transmitted spectrum. It is found that the pitch of the CLCF increases with VOC gas concentration, which reduces the refractive index (RI) of CLCF and results in a blue shift of the resonant dips. By tracing the blue shift of the resonant dips, the VOC gas sensing characteristic of the CLCFC-SPF were investigated experimentally. For tetrahydrofuran, acetone and methanol gas, the sensitivities of the CLCFC-SPF are respectively measured as 7.08 nm·L/mmol, 3.46 nm·L/mmol, 0.52 nm·L/mmol. Using the wavelength selectively coupling theory, gaseous-optic coefficient of the CLC can also be obtained and were measured in the experiment as 6.6×10-4 RIU·L/mmol, 2.9×10-4 RIU·L/mmol, 0.6×10-4 RIU·L/mmol, respectively, for tetrahydrofuran, acetone, and methanol gas. Additionally, the experimental results also show that both the sensitivity of CLCFC-SPF and the gaseous-optic coefficient of the CLCF increase with the molar mass of the VOC gas. The work provides a way to incorporate the sensitive liquid crystal onto the fiber for implementation of liquid-crystal-based fiber sensors.

Keywords: Side-polished fiber, cholesteric liquid crystal, volatile organic compound gas, fiber sensor

INVITED SPEAKERS

Id-136

High-Sensitivity Detection of Soluble HER2 in Cell Lysates Using A Combined Label-Free and Fluorescence Biosensing Platform

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Abstract: The detection of cancer biomarkers at very low concentrations represents a crucial point in the prevention of cancer diseases. In particular, HER2 over-expression occurs in approximately 20–30% of breast cancers and it is generally associated with a dismal prognosis, collocating breast cancer as the most common, potentially fatal cancer of women[1]. In the present work, we report on the use of one-dimensional photonic crystal (1DPC) biochips to detect clinically relevant concentrations of the breast cancer biomarker HER2 in cell lysates. To this aim, we developed an optical platform, combining both label-free and fluorescence detection, which makes use of 1DPC biochips tailored with monoclonal antibodies for highly specific biological recognition. The excitation of a Bloch surface wave (BSW) was obtained by a prism coupling system, in the Krestchmann-Raether configuration, leading to a dip in the angular reflectance spectrum[2]. The angular displacement of such a dip, due to refractive index perturbations as well as biological reactions at the surface, was exploited for biosensing purposes. Moreover, in the presence of fluorescent labels at the surface, the platform can interrogate the BSW biochip also in the enhanced fluorescence mode. The latter possibility permitted to obtain further information on the cancer biomarker assay and making bio-recognition more robust and sensitive[3]. Indeed, in case of the fluorescence operation mode, a limit of detection below 1 ng/mL, about 10 times lower than label-free approach, was attained, enabling an ultimate resolution for HER2 quantitation. Such a resolution was used to successfully discriminate cell lysates over-expressing different amounts of HER2. To conclude, with the present work, we met international recommendations (threshold of 15 ng/mL for HER 2-positive human serum samples) for diagnostic HER2 assays that in future may help to more precisely assign therapies facing cancer cell proliferation and metastatic spread. Further development of the platform, leading to the fabrication of an integrated point-of-care instrument making use of plastic disposable biochips[4], will be also reported.

Keywords: Optical biosensors, bloch surface waves, 1D photonic crystals, HER2 breast cancer

References:

[1]. S. Dawood et al., *Journal of Clinical Oncology*, **2010**, 28 (1), 92–98.

[2]. A. Sinibaldi et al., *Sensors and Actuators B*, **2012**, *174*, *292*.

[3]. A. Sinibaldi et al., *Biosensors & Bioelectronics,* **2017***, 92, 125-130*.

[4]. R. Rizzo, Biomedical Optics Express, **2018**, 9(2), 529-542.

INVITED SPEAKERS

Id-140

Antibacterial Properties of Polystyrene Films with TiO_x and Cu Nanoparticles Deposited from Gas-Aggregation Sources

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Abstract: Antibacterial media are of high importance for medicine, food production and conservation. In particular, metal or metal compound nanoparticles (NPs) are of attention for many bactericidal applications. Among them are Ag, Cu, Au, CuO, ZnO, Fe_3O_4, Al_2O_3, TiO_2 just to name a few. They can exhibit bactericidal properties through mechanisms based on (i) metal ion selectivity (replacement of original metals leading to cellular dysfunction); (ii) metal reduction potential (generating or catalysing reactive oxygen species (ROS) damaging cellular proteins, lipids and DNA) and (iii) direct NP interaction with bacteria surface (which can lead to blocking of membrane transport channels and disturbing of electrochemical gradients). For more convenience in use and extended applications, NPs can be embedded into polymer films. In the current work, a novel approach for the formation of bactericidal media represented by thin polystyrene (PS) films, produced by spin-coating, with Ti and Cu NPs produced by magnetron sputtering in special cluster sources is tested. Ti NPs are treated in three different ways in order to convert them into TiO_x, namely, they are exposed to (i) ambient atmosphere where they gradually oxidise, (ii) oxygen plasma after the deposition and (iii) in-flight plasma treatment prior the deposition. The oxidised particles possess semiconducting properties which are required for catalysis of reactive oxygen species in order to initiate dysfunction of bacteria. Cu NPs are used as-deposited on PS. They are expected to exhibit bactericidal activity through injection of ions replacing original metals and by blocking the membrane transport channels, thus, leading to cellular dysfunction. Partial embedding of both types of NP into polymer films is realised using thermal annealing in order to improve surface adhesion and make them resistant against wash out. The formed composite films with TiO_x and Cu species are tested against *E.coli* bacteria as model microorganisms. The obtained results show antibacterial efficiency of composites with both types of NPs. Since the mechanisms of deactivating the bacteria are different for semiconducting TiO_x and metallic Cu, the dynamics of bactericidal efficiency is also found to be different. Samples with TiO_x NPs demonstrate very good capability to be reused a number of times for antibacterial purposes. Among them, the samples of type (iii) show the best bactericidal efficiency. The efficiency of all samples does not degrade during long-term storage (over 6 months) after the preparation. However, these composites need an UV illumination that complicates a bit the application. The polymer films with Cu NPs do not require UV light but reusability of them leads to gradual decrease of bactericidal efficiency. On the other hand, these coatings would be cheaper and easier to apply compared to those with titanium oxide particles, thus, becoming

good candidates for a single or a few times use.

Keywords: Antibacterial properties, cluster beam technique, nanoparticles, polymers

INVITED SPEAKERS

Id-142

Advanced Polymer Materials for Construction of Third-Generation Amperometric Enzyme Biosensors

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Abstract: Development of advanced materials such as a novel nanocomposites and polymers suitable for construction of biosensor with improved operational parameters is an important field in the novel sensor technologies. Application of polymer materials as holding matrixes of immobilized enzyme is an innovative approach in a construction of the non-mediated enzyme-based biosensors of the third generation [1]. In the present work, the recent results on the construction of a laboratory prototype of amperometric biosensor based on enzyme, polymer, as a host matrix, and gold planar electrode, which may be perspective for monitoring the level of wastewater pollution, are reviewed. For the first time, we have reported construction of the innovative amperometric biosensors of the third generation using the organic-inorganic ureasilicate (shorten name 'ureasil') based composites and commercial laccase from *Trametes versicolor* [1]. The constructed biosensor based on the ureasil/chalcogenide glass (As_2S_3) composite was characterized by a very high sensitivity, but a weak point of the biosensor was very strong unexpected electrochemical noise at chronoamperometric measurement. At the same time, new perspectives of the ureasil-based polymers for construction of amperometric enzyme biosensors were further found [2-4]. In particular, a correlation between the network properties of the biosensor sensing layers (e.g., free volume V_h at glass transition temperature T_g and coefficients for the thermal expansion of free-volume holes α_{F1} and α_{F2} in the regions below and above T_g as well as their difference ($\alpha_{F2} - \alpha_{F1}$), and swellability or crosslink density) based on the pure ureasil and ureasil/As_2S_3 composites of different history (fresh and aged samples) and biosensor characteristics (e.g., a maximal current at substrate saturation I_{max}, apparent Michaelis-Menten constant K_M^{app} to ABTS chosen as a substrate, the slope of the calibration curve B, and the sensitivity of bioelectrodes obtained by means of cycle voltammetry and chronoamperometric analysis) was established. Further research showed an enhancement of the sensitivity of the laccase based bioelectrodes using enzyme-immobilized gold nanoparticles (Au-NPs) coupling with the ureasil/As_2S_3 polymer as a host matrix [5]. For comparison, the construction and characterization of biosensor based on laccase and Nafion polymer modified with TiO_2-NPs were also performed. The effect of oxide TiO_2-NPs was found to be similar with As_2S_3-nanostructures and Au-NPs.

Keywords: Organic-inorganic ureasil polymer, ureasil-chalcogenide glass composite, positron annihilation, swelling, free volume, cross-linking, enzyme, laccase, amperometric biosensor

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References

[1]. T. Kavetskyy et al., J. Appl. Polym. Sci., 134, 45278(1-7) (2017).
[2]. T. Kavetskyy et al., Acta Phys. Pol., A, 132, 1515-1518 (2017).
[3]. T. Kavetskyy et al., NATO SPS B: Phys. Biophys., 309-3016 (2018).
[4]. T. Kavetskyy et al., NATO SPS B: Phys. Biophys., 333-338 (2018).
[5]. T. Kavetskyy et al., Gold Bull., submitted (2018).

INVITED SPEAKERS

Id-143

Dual Functionality of Sulfated Glycosaminoglycans – Impact for The Development of Biomedical Wound Dressings

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Abstract: Native hyaluronan (HA) as non-sulfated glycosaminoglycan (GAG) or functionalized derivatives thereof are widely used as building blocks in regenerative medicine. Sulfated GAGs like the naturally occurring chondroitin sulfate (CS) and heparan sulfate are structural and reservoir-forming matrix components of great physiologic relevance. Especially HA derivatives with crosslinkable thiol or acrylate groups are broadly used to generate three-dimensional structures. The highly variable sulfation motifs of GAG direct the interactions with biological mediator proteins thereby regulating the cell behavior. Recent developments in the design of functional biomaterials thus apply chemically sulfated GAG for tailoring interaction with cells (Salbach et al. 2012). Based on findings and developments of our group in the Collaborative Research Centre TRR67 “Functional Biomaterials for Controlling Healing Processes in Bone and Skin - From Material Science to Clinical Application”, data on dual functions of sulfated GAGs depending on their way of use will be presented: (1) Soluble sulfated GAGs may impair the biological activity of mediators in the cellular microenvironment by binding them in a moiety that is essential for the interaction with their receptor. In this case, the biological activity of the mediator may be reduced due to scavenging resulting in reduced signaling as shown for transforming growth factor-β1 (TGF-β1) (van der Smissen et al. 2013). Here the increased binding of sHA to TGF-β1 compared to HA, which was demonstrated via surface plasmon resonance analyses (Hintze et al. 2012) corresponded to this sulfation-dependent effect on the TGF-β1 activity. This strong interaction may be the reason for the observed effects of sulfated HA on fibroblast biology like decreased myofibroblasts differentiation (van der Smissen et al. 2013) or modified expression of matrix proteins (van der Smissen et al. 2011; Muller et al. 2012). (2) On the other hand, biomaterials with incorporated sulfated GAGs which reversibly bind and release mediators may support long lasting stability and activities of mediators in the wound milieu. This could be demonstrated by using StarPEG-Heparin-hydrogels which bind and release TGF-β1 preserving its activity (Watarai et al. 2015). Recent data demonstrate a more effective interaction of heparin binding EGF-like growth factor (HB-EGF) with sulfated HA compared to the unmodified polymer after chemical incorporation into collagen-HA-based hydrogels. Again, this interaction is reversible and we show that the formerly bound HB-EGF keeps its wound-healing-related activity after the release from the hydrogels (*Rother S et al. under revision*). Taken together, sulfated GAGs are promising components for the functionally directed engineering of smart biomaterials to guide tissue responses and to improve wound healing.

Keywords: Sulfated glycosaminoglycans; Hyaluronan; Growth factor; Wound healing.

Acknowledgement: Presented work was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 59307082 – TRR67.

References

[1]. Hintze, V, Miron, A, Moeller, S, *et al.* (2012). Sulfated hyaluronan and chondroitin sulfate derivatives interact differently with human transforming growth factor-β1 (TGF-β1). *Acta Biomater* 8: 2144–52.

[2]. Muller, SA, van der Smissen, A, von Feilitzsch, M, *et al.* (2012). Quantitative proteomics reveals altered expression of extracellular matrix related proteins of human primary dermal fibroblasts in response to sulfated hyaluronan and collagen applied as artificial extracellular matrix. *J Mater Sci Mater Med* 23: 3053–65.

[3]. Salbach, J, Rachner, TD, Rauner, M, *et al.* (2012). Regenerative potential of glycosaminoglycans for skin and bone. *J Mol Med* 90: 625–35.

[4]. van der Smissen, A, Hintze, V, Scharnweber, D, *et al.* (2011). Growth promoting substrates for human dermal fibroblasts provided by artificial extracellular matrices composed of collagen I and sulfated glycosaminoglycans. *Biomaterials* 32: 8938–46.

[5]. van der Smissen, A, Samsonov, S, Hintze, V, *et al.* (2013). Artificial extracellular matrix composed of collagen I and highly sulfated hyaluronan interferes with TGFbeta(1) signaling and prevents TGFbeta(1)-induced myofibroblast differentiation. *Acta Biomater* 9: 7775–86.

[6]. Watarai, A, Schirmer, L, Thönes, S, *et al.* (2015). TGFβ functionalized starPEG-heparin hydrogels modulate human dermal fibroblast growth and differentiation. *Acta Biomater* 25: 65–75.

[7]. Rother, S, Thönes, S, Wippold, T et al. Hyaluronan/collagen hydrogels containing sulfated hyaluronan increase efficiency of HB EGF during wound healing. *Acta Biomater under revision*

INVITED SPEAKERS

Id-144

Biomineralization Process in Magnetotactic Bacteria and Calcareous Sponges

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Abstract: Over 60 different minerals are known to be produced by organisms in a process called biomineralization. In biomineralization, organisms passively or actively, but selectively, accumulate chemical elements from the environment and transform them into mineral structures inside or outside the cell [1]. Biomineralization processes play crucial roles in ecosystems as many of these organisms participate in the geochemical cycles of major elements necessary to life. About two billion years ago, after the great collapse of life, which was anoxic, due to the release of oxygen by the activity of cyano bacteria, magnetotactic bacteria appeared. There is the first organism which syntheses crystal, magnetite or greitgite. 0.5 billion years ago appeared sponges which are the firts multicellular organisme. Many sponges have internal skeletons of spongin and/or spicules of calcium carbonate or silicon dioxide. In general, the formation of minerals is under precise biological control and is mediated by a mineralization process, which is known as biologically controlled mineralization. this phenomenon will be illustrated by the presentation of two processes of biomineralization, that of magnetite in the case of magnetotactic bacteria [2] and spicules of calcite in the case of sponges of the calcareous species [3].

Keywords: Biomineralization, magnetotactic bacteria, calcareous sponge

Acknowledgements: CNPQ, FAPERJ Brazil and LIA-CNRS France

References

[1]. Weiner, S. & Dove, P. M. An overview of biomineralization processes and the problem of the vital effect Rev. in Mineral. Geochem. 54, 1–29 (2003).

[2]. J. Werckmann et al., Localized iron accumulation precedes nucleation and growth of magnetite crystals in magnetotactic bacteria, Sci. Rep. 7 (2017

[3]. A.L. Rossi et al., Long-range crystalline order in spicules from the calcareous sponge Paraleucilla magna (Porifera, Calcarea), Acta Biomater. 10 (2014).

INVITED SPEAKERS

Id-147

A Comprehensive Look on Bioceramic Powder Synthesis

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Abstract: Bioceramic materials have an essential place in biomaterials field. Both hard and soft tissue healing and renewal applications are in focus of bioceramics. There are 3 main types that bioeceramics can be classified into depending on the material-tissue response. Bioinert, bioactive and bioresorbable ceramics all have specific usage areas, especially for the orthopedic and dentistry surgeries. Bioactive hydroxyapatite, bioinert alumina and bioresorbable glasses can be defined as the pioneers of their material-tissue interaction group. Hydroxyapatite (HA, $Ca_{10}(PO_4)_6(OH)_2$) constitutes the inorganic component of the bone. Hence, it is a widely studied bioceramic and research work based on obtaining HA with different morphologies, enhanced mechanical properties and surface modifications still proceed due to the need for a material that possess features just as the rigid part of the hard tissues. There are several methods developed to produce HA from synthetic chemicals and natural sources such as bovine bones, seashells, eggshells, etc. α-Alumina (α-Al_2O_3) is a structural advanced ceramic material which is also famous for being used for implants that require hardness and wear resistance. A favorable solution to achieve α-Al_2O_3 is the sol-gel technique. Although it is a method with a chain of sequential steps, sol-gel process enables products with superior characteristics, i.e. high purity and morphological diversity. Bioactive/bioresorbable glasses are surface-active bioeceramic materials so that they have the ability to efficiently form calcium phosphate (CaP) based precipitations on their surface when implanted in body tissues. Special compositions of the bioactive glasses ensure high bioactivity and therefore accelerate the recovery process. Sol-gel technique and conventional melting-quenching method can be applied to acquire bioactive glasses considering the properties of the aimed outcome, i.e. porosity, particle shape, etc. In this review, bioceramics of high importance are handled in terms of their synthesis procedures and characterization analyses in the context of our completed and ongoing projects. Moreover, preparation of bioceramic composites and investigation of their physical, chemical, mechanical and bioacitivity features are also discussed.

Keywords: α-Alumina; Calcium phosphates; Bioactive glasses; Wet synthesis methods; Bioceramic composites.

INVITED SPEAKERS

Id-148

The Use of a Novel Microfluidic Culture Device to Improve Murine Embryo Quality *in Vitro*

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Abstract: Genetically altered (GA) mice are used extensively to study the function and regulation of genes and their role in human development and disease. The generation of GA mouse models involves one of three techniques that use embryos at different stages of development: (i) pronuclear injections; (ii) in vitro fertilisation (IVF); or (iii) embryonic stem cell injection. Embryos from all three approaches are transferred into pseudopregnant recipients primarily using surgical techniques performed under general anaesthesia. In recent years, Non-Surgical Embryo Transfer (NSET) techniques have been developed for trans-cervical transfer of blastocysts, morulae, DNA-microinjected embryos, and embryonic stem cell-containing embryos in the uterine cavity. NSET technology avoids surgery and improves animal welfare. However, the NSET techniques can only be used to transfer late stage pre-implantation embryos, and current approaches for extended culture of one and two-cell embryos generated from IVF programmes or following pronuclear injection severely compromises their implantation success. This means that these common techniques do not get used in conjunction with the current NSET systems. Further optimization of murine embryo culture techniques is required to enable the use of NSET approaches with all stages of embryo to improve implantation and pregnancy rates. This study aims to improve the implantation rates of early stage embryos when combined with extended *in vitro* culture and NSET techniques. We designed and fabricated by soft lithography single-use, sterile, microfluidic devices in polydimethylsiloxane for the culture of murine 1 cell zygotes. 1: 2 cell embryos were thawed and cultured in groups of 10 in microfluidic devices or 10µl control drops for 3 days under 5%CO_2/5%O_2/N_2 balance to complete non-invasive analysis of glucose (G), pyruvate (P) and lactate (L) metabolism in spent zygote culture media from the microfluidic cultures. Data were compared to control embryos grown in conventional microdrop cultures under oil. Cryopreserved embryos of strain C57BL/6N were provided by MRC Harwell, UK. Blastocyst, hatching, pyruvate and glucose consumption did not differ between device and control groups. Lactate output was significantly reduced following device culture vs controls (4.1±0.8 vs 1.4±0.3 pmol/embryo/hr, P=<0.0001, n=46). In house validation of the device and embryo transfer trials at MRC Harwell centre has shown maximization of the blastocysts rate (100%), improved birth rates (53%) when transferring embryos cultured for 48hrs in the devices with surgical procedures. When combined with NSET, the microfluidic culture ensured successful implantation of *in vitro* matured blastocysts (with success rate>25%).Device culture was non-toxic and did not affect embryo development. However, blastocyst pyruvate consumption and lactate

output were reduced compared to controls.

Keywords: Microfluidic, embryo culture, PDMS

INVITED SPEAKERS

Id-153

Chiral Plasmonic Sensing

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Abstract: The structure of a protein is an important property that determines its functionality. It dictates how the proteins interact with other molecules, which is significantly important in medical diagnostics that use proteins to detect markers for disease or therapeutic drugs that interact with proteins in the body. Determining the changes to protein structure can be used for determining protein-protein or protein and small molecule interactions. However, determining the structure of a protein requires detailed, tedious and expensive techniques such as x-ray crystallography. Optical spectroscopy techniques are not sensitive to the entire structure of a protein and all these methods require large sample quantities, eliminating their use for rapid routine diagnostics. Chiral Plasmonic Sensing (CPS) exploits a new class of label-free biostructure sensitive tests (assays) for diagnostics based on the interaction of asymmetrical metamaterials with proteins.[1,2] They can be used to create a new form of structurally sensitive technology that we call "Chiral Plasmonic Assays" (CPAs) which will enable applications such as detection of multiple pathogens and improve drug discovery techniques. Our work looks at exploring the intrinsic properties of chiral plasmonics to optimize and engineer chiral nanostructures and the instrumentation in order to make this scientific discovery into a real life technological impact. In this presentation I will discuss the background discovery of chiral plasmonics, advances in our understanding of the biophysical interactions and development of the technology.

Keywords: Plasmonics; Biosensing; Chirality; Metamaterials.

References:

[1]. Hendry, E.; Carpy, T.; Johnston, J.; Popland, M.; Mikhaylovskiy, R. V.; Lapthorn, A. J.; Kelly, S. M.; Barron, L. D.; Gadegaard, N.; Kadodwala, M., Ultrasensitive detection and characterization of biomolecules using superchiral fields. Nat Nanotechnol 2010, 5 (11), 783-787.

[2]. Karimullah, A. S.; Jack, C.; Tullius, R.; Rotello, V. M.; Cooke, G.; Gadegaard, N.; Barron, L. D.; Kadodwala, M., Disposable Plasmonics: Plastic Templated Plasmonic Metamaterials with Tunable Chirality. Adv Mater 2015, 27 (37), 5610-5616.

INVITED SPEAKERS

Id-154

Challenges in The Commercialization of a Capillary Electrophoresis Microfluidic Platform

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Abstract: Eleven years after the iconic article from Whitesides about the origin and future of microfluidics, handling of liquids in micro channels is finally starting to hold up to its promise. With a market share expected to reach 10 billion dollars by 2024, transnational to medium and small scale enterprises are turning towards microfluidics prototyping, fabrication, scaled up production or simply development of microfluidic devices performing various tasks. In most of the cases those devices seek to substitute complex and labor intensive laboratory equipment with small, handheld instruments, operated by non-scientific personnel. Although there are numerous applications for microfluidics with proof of concepts successfully demonstrated in the laboratory, the commercialization of such concepts can face many obstacles and not straight forward solutions. In this paper we demonstrate the numerous issues experienced during the development of a capillary electrophoresis microfluidic platform for soil sample analysis. The challenges faced during the commercialization of the device can be summed up to the following categories: chip and electrode fabrication, fluidic interface and connections, pumping mechanism, chip exchange mechanics electrical connections and electronics, manufacturability, usability and reproducibility. The chip production had to go through different phases, starting with the laboratory version of the chip. As many laboratory prototypes do it was implemented using glass and polydimethylsiloxane (PDMS). PDMS though being extensively used in early stage studies, poses serious obstacles in scaled up processes. In short, its production cannot be easily automatized. For an intermediate stage (prior to mass manufactured) chip design we utilized rapid prototyping techniques such as laser milling, for grafting the channel on a thin PET foil. Inkjet printing was used for producing the electrodesCurrent development in under way of scaling up the chip production, experimenting with the roll-to-roll imprint method, hot embossing and injection molding. One major problem raised in microfluidics is the bubble formation, which for a capillary electrophoresis device they disarray the measurements due to the disruption of the separation voltage. Several bubble removal strategies were tested. A combination of those strategies along with a specially designed chip - buffer reservoir fluidic interface, rendered our device bubble free. Lastly, considerable efforts were made for addressing other pressing issues towards designing a commercial handheld device. Since the targeted end users are middle size farm growers the functionality and usability of the device should be of high standards. That implies that the liquid handling, chip exchange mechanism etc should be as automated and simple as possible.

Keywords: Microfluidics, sensors, lab-on-chip

INVITED SPEAKERS

Id-168

Low Cost Sensors for Rapid Medical Diagnosis and Environmental Health

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Abstract: Biosensors (e.g. glucometer, paper strip for pregnancy test) has attracted increasing attentions in the areas of medical diagnosis and environmental monitoring, in particular cost-effective sensors for point-of-use analysis. We have recently proposed the unique concept of community sewage sensors, where rapid online sensors were deployed to detect and monitor biomarkers and pathogens in sewage to inform public health interventions. This was demonstrated by detecting illicit drug use trends from sewage samples in collaboration with Wessex Water Ltd and European Monitoring Centre for Drugs and Drug Additives (EMCDDA), as well as by monitoring human DNA markers using point-of-use sensors. In collaboration with the EU Cost Action (ES 1307), we contribute to monitoring illicit drug use trends throughout 28 countries and 70 cities in Europe in the year of 2017. Recently, we developed in-field DNA testing sexually transmitted diseases for cattle in India, in a new paper-based format with the Indian Veterinary Institute. The devices were implemented for the rapid testing of Malaria in Uganda in Africa for the diagnosis of infectious disease. The device is also implanted for the rapid tracing microbial source to monitor water quality.

Keywords: Biosensors, glucometer, paper strip, pregnancy test

INVITED SPEAKERS

Id-169

Biocomposites As Active Materials for Wound Management

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Abstract: Nature is a source of numerous macromolecules with specific chemical compositions and peculiar functions. Natural polymers can be extracted or isolated from plants and seaweed (starch, cellulose, pectin, alginate, carragreenan, gums, zein), from animals (hyaluronic acid, keratin, chitosan, fibroin), fungi (pullulan, chitin), and bacteria (xanthan, gellan, dextran). Properties such as biodegradability, low toxicity, low cost, and sustainability make them ideal candidates to substitute synthetic polymers in biomedical and pharmaceutical applications. Those natural polymers, in combination with natural bioactive substances like essential oils and vegetable extracts, or with synthetic drugs, can be used as starting materials for engineering various drug delivery systems or scaffolds, like free standing films, fibrous membranes, gels, emulsions, microparticles suspensions, and coatings. In this presentation, we will make an overview of these systems, emphasizing the unique capabilities they possess for wound healing applications. With the various active biocomposites systems we target a good protection of the wounds from infections and dehydration and a sufficient regeneration of cells by inducing a controlled delivery of antibiotics or other therapeutic substances (e.g. antioxidant, anti-inflammatory, antimicrobial agents and growth factors) or natural active agents to the wound even in a sequential way. Some examples that will be presented are sodium alginate and fibroin and keratin-based electrospun membranes, multilayered films based on PVP and hyaluronic acid, keratin and zein microparticles, emulsion where hydrophobic and hydrophilic active principles coexist, etc. Different methods that control the delivery time of the active agents from the biocomposites to the wound, including controlled crystallization or multilayer geometries will be also presented.

Keywords: Biopolymers; Wound management; Electrospinning.

INVITED SPEAKERS

Id-170

Soil Improvement Using Ureolytic Bacteria and Monitoring Tools

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Abstract: Biocementation is being investigated as soil improvement technique alternative to use cement or other hydraulic binders. It consists in using ureolytic bacteria, living or added to the soil, to produce calcium carbonate if fed by a solution containing urea and a calcium source. This calcium carbonate is stable in the mineral form of calcite and is named biocement. There are many experimental studies on this technique, in which bacteria and feeding dosages are tested and related, however only few field cases exist and they are necessary to validate and consolidate this technique into practice. This paper starts with a brief presentation of the technique and its working principle, including how to ensure bacterial survival in the soil. Then, practical aspects concerning its implementation in field cases is discussed, concerning the potential porous materials that can be treated, how to produce large quantities of bacteria and, at last, how it can be monitored in the field. Monitoring tools are discussed further considering the development of biosensors, which are pointed as a valuable complement to the usual in situ soil prospection techniques used in such application.

Keywords: Ureolytic bacteria; Biocement; Biosensors; Soil improvement.

INVITED SPEAKERS

Id-177

Applications of Inertial Focusing in Continuous-Flow Microfluidics

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Abstract: Colloidal suspensions of buoyancy neutral particles flowing in circular pipes focus into narrow distributions near the wall due to lateral migration effects associated with fluid inertia [1]. In rectangular geometries, suspended particles migrate to at least four stable equilibrium positions along the channel periphery and are conditions by a special relationship between the size of the particles and the size of the pipes. These equilibrium positions can be collapsed into just two streams in high aspect ratio cross-section channels and into one single stream by employing curvilinear channels that induce Dean flows. The most part of the biological cells and microorganisms of interest in biology range from hundreds of nanometers to tens of micrometers which brings the size of the pipes having an inertial effect on these entities in the microfluidics range. Consequently, many sample preparation applications related to the concentration, filtration and separation of biological species in continuous-flow microfluidics can be envisaged. The presentation will begin with a short introduction to the inertial focusing effect and some special configurations of interest for microfluidics. Different strategies for optimizing the focusing streams and increasing both efficiency and throughput of the separation will be also presented. A simple analytical model for the twin tubular pinch effect in curving flows [2] with special design rules and experimental validations will then follow. The presentation will end with few applications on the separation and concentration of Phytophthora ramorum from soil samples [3] demonstrating more than 5-fold increase in pathogen content with 95% recovery rate.

Keywords: Microfluidics, inertial focusing, tubular pinch effect

References

[1]. G. Segré, A. Silberberg, Radial particle displacements in Poiseuille flow of suspensions, Nature, vol. 189, 1961

[2]. L. Clime, K. J. Morton, X. D. Hoa, T. Veres, Twin tubular pinch effects in curving confined flows, Nature Scientific Reports, 5(1), 9765, 2015

[3]. L. Clime, K. Li, M. Geissler, X. D. Hoa, G. P. Robideau, G. J. Bilodeau, T. Veres, Separation and concentration of Phytophthora ramorum sporangia by inertial focusing in curving microfluidics flows, Microfluid Nanofluid, 21(1), 5, 2017

INVITED SPEAKERS

Id-178

Assembling Nanobiomaterials For Diagnostic and Treatment of Diseases

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Abstract: Nanobiomaterials have proven to hold great promise for development of innovative platforms with potential use in emerging applications, *e.g.* diagnostic devices, imaging contrast, drug delivery and therapeutic systems. Novel properties and functions of nanomaterials coming from their dimensions, differ from the concomitant bulk materials counterparts [1]. Rational design of biological structures and their assembly with the nanomaterials allows on-demand development of nanobioengineered platforms with improved properties and outstanding performance. In this context, new nanobiotechnology-enabled medical devices aim to provide not only convenient real-time diagnosis of diseases, closer to the patient, but also opportunities for a more efficient drug delivery and targeted therapeutic, with respect to conventional technologies. Whereas nano-bioprobes achieve a high response to very small targets in practical conditions, they are used to develop superior sensitive and specific assays and agents, with reduced time-scale of testing and minimal requirements of samples volume. Diagnostic tests and devices based on biosensors are being increasingly exploited as valuable alternatives to standard laboratory instrumentation for clinical diagnosis, allowing simple, inexpensive and point-of-care testing systems. Biosensors are usually designed to be highly selective, sensitive, fast, portable, and easy to operate. They can be reusable, affordable, generally having responses that correlate to different analyte concentrations. Functional nanobiomaterial-based assemblies have been used also for efficient encapsulation of active principles and their space-temporal controlled delivery. They can be rationally designed to encapsulate high amount of therapeutic principles and to selectively release them at a specific place and in a controlled manner. Furthermore, nanocapsules protect the cargo from degradation and increase its concentration in the site of action, decreasing the required doses and administration frequencies, thus improving the efficiency and efficacy of therapies with respect to regular therapeutic regimens. This invited talk is aimed to review and discuss novel hybrid nano-bioengineered materials-based functional platforms that have been developed in our group for diagnosis and treatment of diseases. In the first part it will highlight innovative approaches regarding: i) Biosensors for the specific and highly sensitive pathogen detection, in a simple format [2], ii) Novel superior, hybrid nano(bio)platforms for the development of electrochemical (bio)sensors of improved performance [3]; and iii) Differential nanogenosensors for diagnosis of Zika virus and its discrimination among related viruses such as dengue and chikungunya. In the second part, the talk will cover aspects related to: iv) New strategies for encapsulation of therapeutic agents into functionalized nanoparticles to fight intracellular infections; and v) Functionalized photosensitive polymeric nanocarriers for specific delivery of cargo in cardiomyocytes. Overall, the talk will demonstrate the enormous potential of

nanobiomaterials for tackling real problems in today´s world and will highlight their opportunities for multiple applications in clinical diagnostic and therapy.

Keywords: Nanobiomaterials, nanobiosensors, nanocarriers

Referances

[1]. Chi *et. al.* Nanoprobes for in vitro diagnostics of cancer and infectious diseases. Biomaterials 33 (2012) 189-206.

[2]. Vásquez, *et. al.* Amperometric biosensor based on a single antibody of dual function for rapid detection of *Streptococcus agalactiae*. Biosensors and Bioelectronics 87 (2017) 453–458.

[3]. Soto, *et. al.* Electroanalysis of an iron@graphene-carbon nanotube hybrid material. Electroanalysis 30 (2018) 1521–1528.

INVITED SPEAKERS

Id-187

A Solid-State Sensitive Optical Sensor Based on Plasmonic Nanopaper

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Abstract: In this research, we present novel optical sensors that uses bacterial cellulose (BC) as a nano-based platform. The significant and versatile features of BC such as optical transparency, mechanical strength, nano-fibers structure, flexibility and abundant functional groups, make this natural biopolymer a perfect substrate to create a new generation of optical biosensors. Importantly, the coupling of BC with advantageous nanomaterials (e.g., plasmonic nanoparticles and biomolecule) leads to the emergence of multifunctional nanocomposites. As such, we have used the outstanding characteristics of BC embedded with plasmonic nanoparticles (Ag and Au) for the fabrication a plasmonic nanopaper. Hence, we were able to fabricte a solid state sensor to detect volatiles and bacteria that is versatile, sensitive, selective, friendly, in-situ and rapid detection. We observed that the nanocomposite composed of BC and plasmonic nanoparticles offered the most important features of both. Its transparency allowed the use of a spectroscopy device for the accurate measurement of the modulation in the nanoparticles due to either etching or aggregation. Consequently, the small changes were revealed through their UV-vis absorbance spectra and plasmonic peak. Besides, for gas detection, the high porosity, nanoporous structure, and high surface area of BC enhanced the contact of plasmonic nanoparticles and the desired molecules of volatile compounds, as well as reducing the time of contact. Moreover, high mechanical properties guaranteed its sustainability and stability during usage. Given to these features, colorimetric detection of ammonia vapor and spoilage food were successfully developed through plasmonic properties of AgNP embedded within BC. It resulted in the color change of silver plasmonic nanopaper from dark amber to light amber or gray, respectively due to the etching of AgNP. Taking all these aspects into consideration, it is envisaged that the opportunities offered by nanocellulose will revolutionize the sensing technology, especially those fabricated based on glass, paper, and plastic. Further advances would be expeditious, due to their compatibility with recent mobile phone-based sensing approach.

Keywords: Bacterial cellulose, plasmonic nanoparticles, nanopaper, gas detection, food spoilage

INVITED SPEAKERS

Id-190

Electroanalysis in Biochemical and Biomedical Researches

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Abstract: Biomolecules as recognition elements in the electrochemical biosensor analysis are widely used due to high substrate specificity, sensitivity, and the development of theoretic laws and fundamental kinetic regularities for calculating the parameters of enzymatic/affine/redox reactions proceeding on the electrode. Hemoproteins (cytochromes P450, cytochrome c), DNA, pharmaceuticals were used as recognition elements of electrochemical biosensors. Electrode/cytochromes P450 systems are analysed in terms of the mechanisms underlying P450-catalyzed reactions. Electrochemical parameters were used for calculations of kinetic constants of enzymatic processes and electrode kinetics of electrons transfer. Bioelectrocatalysis-based screening of potential substrates or inhibitors of P450 enzymes, the stoichiometry of the electrocatalytic cycle, and oxidation-reduction (redox) thermodynamics are described. Based on the analysis of electrocatalytic activity of various isoforms of P450 cytochromes (2B4, 1A2, 3A4, 51b1, 11A1 (P450scc), 17A1, BM3, 260A1, 109C1, 109C2 and 109D1) developed a method of pharmacokinetic therapeutic drug monitoring. The method of the analysis of electrochemical activity of proteins and peptides based on registration of electro oxidation of amino acids and a technique of amino acid substitutions, modifications and formation of functionally significant complexes is developed. Direct redox activity of different proteins was investigated on the surface of carbon screen-printed electrodes (SPE). Modification of electrode surface is important step in biosensor preparation. Highly stable fine dispersions of MWCNTs in aqueous solutions of polyionic liquids PILs (MWCNT/PIL) were used for dsDNA and cytochrome c assay as apoptosis markers. The linear ranges for the determination of dsDNA correspond to 5–500 μg/mL (for G) and 0.5–50 μg/mL (for A). We demonstrate that the developed MWCNT/PIL constructs are able to sense a point mutation in the 12-bases single-stranded DNA fragments. Such detection is of high clinical significance in choosing an adequate anticancer treatment, where the electrochemical identification of the point mutation could offer time and cost benefits.

Keywords: Electrochemistry, cytochrome P450, carbon nanotubes, DNA, hemoproteins

Acknowledgement: The studies were supported by the Program for Basic Research of the Russian State Academy of Sciences for 2013–2020 and by the Russian Science Foundation (RSF- DFG, project no. 18-44-04011).

INVITED SPEAKERS

Id-195

A Microfluidic Platform Facilitating Automated Measurements of Gene Expression and Noise Dynamics During Single-Cell Aging

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Abstract: Yeast *Saccharomyces cerevisiae* is a commonly used model organism for replicative aging studies. However, conventional lifespan measurement techniques have had several limitations. We developed an automated microfluidic platform that facilitates simultaneous lifespan and gene expression measurements of aging yeast cells. Our multiplexed high-throughput platform offers the capability to perform independent lifespan experiments using different yeast strains or growth media. Using this platform, we measured the full lifespan of individual yeast cells in wild-type and canonical gene deletion backgrounds. Tracking the activity of the galactose utilization network in cells throughout their lifespan elucidated how gene expression levels and noise in gene expression dynamically change during the aging of the host cell. Aging-associated increases in chromatin state transitions were hypothesized to be behind the observed gene expression and noise dynamics, and a stochastic model provided quantitative support to the proposed mechanism. High-precision gene expression and replicative aging measurements made through the use of microfluidic platforms can offer novel insights into aging dynamics and lifespan determinants in single cells.

Keywords: Microfluidics, aging, yeast, gene expression, noise

INVITED SPEAKERS

Id-196

A Sustainable Cellulose Coating for Self-Cleaning-Healing Fabric

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Abstract: Recently, an increasing trend has been noticed towards synthesizing superhydrophobic surface due to its many potential applications including water repellency, oil spill recovery, self-cleaning, antifouling, anti-icing-deicing and fabrics. Typically, a self-cleaning fabric possesses superhydrophobic surface. Unfortunately, till date majority of the superhydrophobic surfaces are created by utilizing fluorinated compounds or carbon/inorganic nanoparticles knowing their adverse effects on human health and environment. Therefore, this article presents a simple methodology for developing a novel sustainable superhydrophobic coating with the aim to produce self-cleaning and healing fabrics. The coating was developed using cellulose nanofibers (CNFs) as the raw material. When applied this coating on various fabrics (cotton and polyester), they became superhydrophobic with WCA of 152-156°(±3), thereby most liquid droplets rolled like round balls on the surfaces, leading to form self-cleaning fabrics. Moreover, the coated fabrics can quickly restore the self-healing property upon heating.

Keywords: Nanocellulose, superhydrophobic, multifunctional composites

INVITED SPEAKERS

Id-197

Diazonium Surface Chemistry: A Versatile Approach for Creation of Novel Materials

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Abstract: The lecture will be dedicated to the implementation of stable arenediazonium tosylates for the creation of smart materials with pre-determined surface functionality. Thus, the basic principles of polymer surface modification will be discussed as well as the potential ways for the application in the wettability control [1]. The specific design of smart and stimuli-responsive materials for the fine control of wettability and adhesion by electric field or other physical stimuli will be explored [2]. The second part of lecture will be dedicated to the design of surface functional materials based on plasmon-active thin gold films. The role of surface modification and nature of functional groups will be discussed in terms of the influence on the properties of desired materials [3]. Finally, the basic approaches to the transformations of organic functional groups on the surface as well as the further application of modified materials for the sensor technologies will be reviewed. Both area of interests is perfectly combined in the investigation of polymerization of stimuli-responsive compounds induced by surface plasmon-polariton [4]. Finally, the definite examples of the sensors for the detection of biologically-relevant analytes will be discussed [5].

Keywords: Diazonium, surface functionalization, SERS, sensors, wettability, polymers

Referances

[1]. Postnikov, Lyutakov et al., Appl. Surf. Sci., 2017, 397, 226; J. Polym. Sci., A. 2017, 55, 378; RSC Advances, 2018, 8, 11198.

[2]. Postnikov, Lyutakov et al. Adv. Mat. Interf., 2017, 4, 1600886; Adv. Mat. Interf., 2018, 5, 1701182; ACS Appl. Mat. Interf., 2018, 10, 37461; Adv. Mat. Interf., submitted.

[3]. Postnikov, Lyutakov et al., Coll. Surf. A., 2017, 516, 274; Appl. Surf. Sci., 2018, 433, 443; Adv. Mat. Interf., 2018, 5, 1800725; Langmuir, 2018, 34, 12861.

[4]. Postnikov, Lyutakov et al., J. Phys. Chem. C., 2018, 122, 26613; Adv. Mat. Interf., 2018, 5, 1801042; Langmuir, 2019, accepted.

[5]. Postnikov, Lyutakov et al., ChemNanoMat, 2017, 3, 135; Sens. Act. B., 2017, 253, 830; Sens. Act. B., 2018, 265, 182; Appl. Surf. Sci., 2018, 479, 219.

INVITED SPEAKERS

Id-213

A Single-cell Study of Mitochondrial Function and Biphasic Dose Response in Low Level Laser Therapy

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Abstract: It has been reasonably well established that mitochondria are a principal intracellular target of red and near-infra-red light. Cytochrome C oxidase (unit IV of the mitochondrial respiratory chain) is a chromophore that absorbs light as far into the infra-red as 1000 nm. Recent results show that low level laser therapy (LLLT) not only enhances mitochondrial respiration, but also activates the redox-sensitive NF-kB signaling via generation of intracellular reactive oxygen species (ROS). The purpose of this study is to conduct a single-cell study of mitochondrial function and biphasic dose response in low level laser therapy using fluorescence-based technology, together with our high-resolution optical tweezers system, fluorescence detection system, microfluidic system, accurate sample temperature control system, micro-scale surface enhanced Raman spectroscopy system, laser-guided direct writing cell bioprinting system and image-based autofocusing system. This seven in one system allows us to probe the generation of ROS and the real-time activation of NF-kappa B signaling circuits by LLLT in single living cells. Here, we apply 830 nm laser to construct a laser-guided direct writing (LGDW) bioprinting system. The LGDW system is integrated into an inverted microscope, together with microfluidic flow chamber, and incorporated an optical tweezers system to manipulate single NIH3T3 living cell in three dimension and then pattern 2D cell arrays in well-defined manner. The LGDW system will further apply to conduct the LLLT photobiomodulation at the single cell level. In addition, the generation of ROS, mitochondrial function, and ATP production can be labeled with H_2DCFH-DA, MitoTracker Red, and Rhodamine 123, respectively, and then detected using an inverted fluorescence microscope (TE2000U, Nikon), equipped with an objective lens (Plan Apo 60x/1.40 oil, Nikon), band-pass filters, and EMCCD camera (LucaEM DL6581, Andor). Furthermore, this integration allows us to realize the effect of LLLT photobiomodulation in multiple doses in different cells in real time. The proposed LLLT photobiomodulation study at the single cell level has never been done before and has the potential to contribute largely to the field of photomedicine. We anticipate this approach allows us to direct monitoring the mitochondrial function in single living cells during LLLT photobiomodulation and to increase the knowledge and understanding of the biphasic dose response during LLLT photobiomodulation.

Keywords: Single-cell Study, Mitochondrial Function, Biphasic Dose Response, Low Level Laser Therapy

INVITED SPEAKERS

Id-214

Thin Films of Oxides Grown by ALD – Properties and Applications

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Abstract: Technology of Atomic Layer Deposition (ALD) allows deposition of ultra-thin films practically at any substrate, including the temperature-sensitive one. This, and the fact that size of growth chamber can easily be scaled to a large volume and that a multi-substrate approach is possible, means that the ALD was an industrial technology from a very beginning. First, it was applied to deposit active part of thin film electroluminescence displays. Then, a real breakthrough came with use of the ALD in micro-electronics to deposit gate oxides. Thin films deposited by the ALD are pin holes free, very dense and show excellent electrical and optical parameters. This is why, in addition to the above-mentioned applications, several new applications of the ALD-grown films are tested. For example, ZnO and Al, In, Ga or F doped ZnO films are intensively investigated for applications in photovoltaics as transparent electrodes. In this case the ALD allows control of films conductivity shifting their plasmonic frequency in a wide spectral range in infrared. This opens chances for several new applications in optics. Moreover, nanolaminar structures of oxides can be deposited by the ALD and used in such applications. For example, nanolaminar structures or monolayers of dielectrics (e.g. of Al_2O_3) can be used as anti-reflection layers, but also to passivate area of back contact in silicon-based solar cells. Some examples of such applications will first be given. Our recent investigations suggest a new and quite unexpected application of wide band gap oxides. Thin films of oxides show surprisingly effective anti-bacterial (anti-microbal) activity. Overuse of antibiotics resulted in the appearance of multi-drug resistant strains and decreasing number of effective drugs. The available data on "hospital bacterial strains" are alarming. It is estimated that 700 000 people dies each year because of infections caused by hospital bacterial strains. These facts motivated the present research. It is aimed to replace widely used antibiotics or coatings with metals. The efficiency of anti-bacterial activity of the ALD deposited oxides was evaluated by measuring the extent of the area in which bacteria growth was inhibited. Importantly, oxide films were deposited at low temperature, allowing coating of range of materials used in clinics, including temperature sensitive ones.

Keywords: Thin films, oxides, Atomic Layer Deposition, anti-bacterial films

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INVITED SPEAKERS

Id-232

Verification of The Efficacy of Targeting Peptides Linked Liposomal Nanoparticles for Therapy of Different Cancers

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Abstract: The efficacy of systemic cytotoxic chemotherapy has been widely assessed in patients with advanced hepatocellular carcinoma (HCC). For example, doxorubicin is the most commonly studied chemotherapeutic agent for HCC. However, it has been shown to have a response rate of only 10-20% in clinical trial. In addition, its potential benefit has been reduced by the related adverse effect. So far, the multikinase inhibitor, sorafenib, is considered to provide survival benefit over supportive care. However, the long term prognosis of those cancer patients still remain poor. Therefore, in the present experiment, we proposed to use the so-called peptide targeting chemotherapy to overcome the adverse event in the conventional targeted chemotherapy. In order to perform this experiment, we have constructed some specific peptides which can bind specifically to the cancer cells and cancer vascular endothelia by using a phage displayed 12-mer random peptide library. We have obtained 3 different peptides and one control peptide. Each contains 12 amino acids: a. L-peptide: RLLDTNRPLLPY (anti-different cancer cell membrane); b. control peptide: RLLDTNRGGGGG; c. SP-94-peptide: SFSHHTPILP (anti-NPC tumor cell and hepatoma cell membranes) and d. PC5-52-peptide: SVSVGMKPSPRP (anti-tumor endothelia). Those L-peptide (L-P), SP-peptide (SP-P), PC5-52-peptide and a control peptide (C-P) were linked to liposomal iron oxide nanoparticles; and to liposomal doxorubicin (L-D). Using peptide linked liposomal iron oxide, we can localize the peptide targeted tumor cells and tumor endothelia, and then we used those peptides linked liposomal doxorubicin to treat SCID mice bearing different cancer xenografts. Our results showed that when L-P-L-D containing 2mg/kg of SCID mouse body weight was used to treat xenografts bearing SCID mice, the tumor could be well controlled, and no specific adverse event was seen. However, when the control peptide was used to replace the specific peptide, the xenograft size was decreased, but the visceral organs revealed marked apoptotic change. In conclusion, the specific peptides linked liposomal doxorubicin nanoparticles can be used for treatment of SCID mice bearing cancer xenografts with minimal adverse event, especially in the SCID mice γ species (NGS), which show a remarkable tumor suppression.

Keywords: Breast cancer, L-peptide, nasopharyngeal carcinoma, peptide histochemistry, peptide-targeted MRI and chemotherapy

INVITED SPEAKERS

Id-242

Biocompatible and Bio-Inspired Micro-and Nano-Structures for Drug-Delivery: Microfluidic-Assisted and Biomimetic Approaches

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Abstract: We present the construction and the application of biocompatible micro- and nano-structures that can be administered systemically and transport in a targeted and effective way drugs, small molecules, stem cells or immune system cells. These polymeric nano-systems represent a primary goal for the treatment of a wide family of neurological/systemic disorders, as well as tumors and/or acute injuries. As natural, biocompatible, biodegradable and non-immunogenic building blocks, alginate and chitosan are been currently exploited. Ionotropic pre-gelation of the alginate core, followed by chitosan polyelectrolyte complexation, allow to encapsulate selected active molecules by means of physical entrapment and electrostatic interactions within sub-micron sized hydrogel vesicles. Here we present a microfluidic-assisted assembly method of nano- and micro-vesicles under sterile, closed environment and gas exchange adjustable conditions- a critical issue, when the cargo to be upload is very sensitive. Polymer/polymer and polymer/drug mass ratio relationship are crucial in order to attain the optimum in terms of shuttle size and cargo concentration. By modulating polymer reticulation conditions, it become possible to control drug loading efficiency as well as drug delivery dynamics. Recent results on the application of the vesicles for the encapsulation and delivery of Inhibin-A and Decorin secreted by Human Adult Renal Stem/Progenitor Cells for Renal tubular cell regeneration will be presented [1]. Moreover, combination of polymeric nano-systems with Superparamagnetic iron oxide nanoparticles (SPIONs) show a pH-responsive behaviour of great significance in controlled drug delivery and targeting of specific sites [2]. Finally, the impact of these polysaccharide sub-micron vesicles on Human Immune cells and the metabolic activity of cells embedded in the micro vesicles will be presented and discussed [3]. A different approach has been followed to biomimetic/bioinspired design and synthesis of structural and functional hybrid organic/inorganic SiO2-based nanostructures (NSs), which present many distinctive advantages over traditional chemical synthesis methods. The intriguing ability of diatom long chain polyamines (LCPAs) to rapidly induce precipitation of SiO2 spheres has motivated the *in vitro* one-pot synthesis of SiO2 particles. Therefore, the templating by amine-bearing molecules is seen as a successful biomimetic approach for the synthesis of SiO2-based hybrids under mild and environmentally friendly conditions for drug-delivery applications [4]. In conclusion, the design of novel hybrid architectures would represent a powerful approach for achieving advanced and smart materials with multiple functionalities and varied purposes.

Keywords: Polymeric vesicles, alginate, chitosan, microfluidic device, magnetic nanoparticles, nanobiosilica, drug delivery, nanomedicine

Referances

[1]. Sallustio, F.; Curci, C.; Aloisi, A.; Toma, C. C.; Marulli, E.; Serino, G.; Cox, S. N.; De Palma, G.; Stasi, A.; Divella, C.; Rinaldi, R.; Schena, F. P., Inhibin-A and Decorin Secreted by Human Adult Renal Stem/Progenitor Cells Through the TLR2 Engagement Induce Renal Tubular Cell Regeneration. Scientific Reports 2017, 7.

[2]. Mandriota, G., R. Di Corato, et al. (2019). "Design and Application of Cisplatin-Loaded Magnetic Nanoparticle Clusters for Smart Chemotherapy." Acs Applied Materials & Interfaces 11(2): 1864-1875.

[3]. Toma, C. C.; Aloisi, A.; Bordoni, V.; Di Corato, R.; Rauner, M.; Cuniberti, G.; Delogu, L. G.; Rinaldi, R., Immune Profiling of Polysaccharide Submicron Vesicles. Biomacromolecules 2018, 19 (8), 3560-3571.

[4]. Della Rosa, G., D. Vona, et al. (2019). "Luminescent Silica-Based Nanostructures from in Vivo Iridium-Doped Diatoms Microalgae." Acs Sustainable Chemistry & Engineering 7(2): 2207-2215.

INVITED SPEAKERS

Id-245

Antimicrobial Activity Magnetite Nanoparticles Decorated with Ag Nps

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Abstract: Antibacterial and antifungal ability of silver nanoparticles (Ag NPs) supported by functionalized magnetite (Fe_3O_4) with 5-aminosalicylic acid (5-ASA) was tested against Gram-negative bacteria *Escherichia coli*, Gram-positive bacteria *Staphylococcus aureus* and yeast *Candida albicans*. Characterization of materials including transmission electron microscopy, X-ray diffraction analysis, and inductively coupled plasma optic emission spectroscopy technique followed each step during the course of nanocomposite preparation. The synthesized powder consists of 30-50 nm in size silver particles surrounded by clusters of smaller (~10 nm) Fe_3O_4 particles. The content of silver in the nanocomposite powder was found to be slightly above 40 wt.-%. Concentration-dependent and time-dependent bacterial reduction measurements in dark indicated that use of Ag NPs leads to the complete reduction of *E. coli* and *S. aureus* even at the concentration level of silver as low as 40 μg/mL. However, the negligible antifungal ability of synthesized nanocomposite was found against yeast *C. albicans* in the entire investigated concentration range (0.1-2.0 mg/mL of the nanocomposite, i.e., 40-800 μg/mL of silver). Complete inactivation of *E. coli* and *S. aureus* was achieved in five repeated cycles indicated that synthesized nanocomposite can perform under long-run working conditions. From the technological point of view, magnetic separation is the additional advantage of synthesized nanocomposite for potential use as an antibacterial agent.

Keywords: Silver nanoparticles; Magnetite nanoparticles; Antimicrobial ability; Charge-transfer complex; 5-Aminosalicylic acid.

INVITED SPEAKERS

Id-248

Clinical Microfluidic Diagnostics Using Nanomechanical Sensor Arrays

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Abstract: Nowadays, finding medical tools able to perform parallel analysis of different factors is the base for clinical diagnostics and prevention. In our lab, we develop microfluidic biosensors that provide non-invasive, rapid and personalised diagnosis for various onsets of disorders resulting from the effect of toxicity, cellular developmental errors or an infection [1]. The device is a nanomechanical analytical platform based on the interaction between microcantilevers and biological samples, where micro dispensing valves permit repeatable injections of sub-microlitre volumes directly into the measurement chamber. Automised switching valves allow the cantilever to experience reduced fluidic effects during sample injection. These biosensors are currently used for several analyses in different clinical fields such as blood viscosity, miRNA transcription level detection and protein recognition, in both static and dynamic mode. In all our measurements the cantilevers array are functionalized using both receptors and internal reference, in order to neglect environmental and nonspecific binding effects. High speed actuation and read-out in the MHz regime allows improving the limit of detection to fM in static mode and pg in dynamic mode in solution.

MicroRNAs are involved at the molecular scale and are extractable biomarkers for a multitude of aberrant biological effects. We detected specific expression patterns of miRNA relevant to cancer from malignant cell lysates. miRNA expression profiles associated with adverse drug effects in hepatocytes derived from necrotic liver tissue were monitored in serum using few microliters within one hour [2]. Clinical coagulation diagnostics often require multiple tests. Coagulation times are the first indication of an abnormal coagulation process, such as a coagulation factor deficiency. In clinical coagulation diagnostics, we used viscosity measurements of human blood plasma coagulating over time to extrapolate several clinical parameters. This is a novel strategy for a quick, reliable and quantitative diagnosis for blood coagulation diseases (e.g. haemophilia) and monitoring factors replacement and anticoagulant therapies (e.g. heparin treatment). We exploit nano oscillations of microcantilevers for real-time measurements in seconds. This approach does not require continuous calibration since it delivers an absolute quantity (clot strength). In conclusion, the presented technique can be used as a versatile point-of-care device for clinical microfluidic diagnostics [3,4] due to the few microliter volume required and the ability to measure different parameters within the same test.

Keywords: Microfluidic, biosensors, microcantilevers

Referances

[1]. Walther, M., Fleming, P.M., Padovani, F., Hegner, M. “An optimized measurement chamber for cantilever array measurements in liquid incorporating an automated sample handling system“ EPJ Techniques and Instrumentation 2,7 (2015).

[2]. Duffy, J., Padovani, F., Brunetti, G., Noy, P., Certa, U., Hegner, M. “Towards personalised rapid label free miRNA detection for cancer and liver injury diagnostics in cell lysates and blood based samples” Nanoscale 10, 12797-12804 (2018)

[3]. Padovani, F., Duffy, J., Hegner, M. “Microrheological Coagulation Assay Exploiting Micromechanical Resonators” Analytical Chemistry 89 (1), 751 (2016)

[4]. Padovani, F., Duffy, J., Hegner, M. “Nanomechanical clinical coagulation diagnostics and monitoring of therapies” Nanoscale 9, 17939 (2017)

INVITED SPEAKERS

Id-249

Nanomaterials Based on Nanocellulose for Biomedical Applications

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Abstract: Nanocellulose is a fast growing research field with several already established applications in the paper industry and as a thickener and binder in foods, cosmetics or textiles [1,2]. For several years, nanocellulose is produced at an industrial scale, in facilities with the capacity of more than one ton/day [1]. A tremendous research effort is now underway to find new applications for this fascinating material and to take full advantage of its extraordinary properties. Nanocellulose possesses a unique combination of properties like high strength and elastic modulus, low density, high water absorption capability, good biocompatibility and hemocompatibility, cell adhesion and proliferation, non-toxicity of itself and its degradation products and large availability of sources [1-5]. All these properties promote nanocellulose for the biomedical field. One of the most promising applications in biomedicine is the development of nanocellulose scaffolds for growing soft and hard tissue [1-6]. A key element in tissue engineering is the structure of the porous scaffold. The pore structure and size must ensure the movement of fluids through the scaffold and the development of the extracellular matrix. Several studies were focused on the study of nanocellulose based materials for tissue engineering, wound healing, cell therapy or 3D cell cultures [1-6]. Collagen, gelatin, alginate, and chitosan-based biomaterials containing nanocellulose were studied for such purposes [1,2,4]. Tuning the porous microstructure of the nanocellulose hydrogels and aerogels by chemical functionalization and cross-linking is important to enlarge cellulose application in tissue engineering and biomedicine. Therefore, preparation and characterization of nanocellulose with different surface properties and nanocomposites based on modified nanocellulose and biopolymers like polyhydroxyalkanoates will be discussed in this lecture. The influence of different methods for surface or bulk modification of nanocellulose on the morphology, thermal stability and mechanical properties of nanocellulose and biocomposites will be thoroughly discussed.

Keywords: Nanocellulose, functionalization, porous structure, biocomposite

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Referances

[1]. A. Dufresne, Nanocellulose - From nature to high performance tailored materials, De Gruyter, 2012

[2]. J. Tang et al. Functionalization of cellulose nanocrystals for advanced applications, J Colloid Interface Sci, 494 (2017) 397

[3]. V.R. Lopes et al. In vitro biological responses to nanofibrillated cellulose by human dermal, lung and immune cells: surface chemistry aspect, Part Fibre Toxicol 14 (2017) 1

[4]. K. J. De France et al. Review of hydrogels and aerogels containing nanocellulose, RSC Adv 6 (2016) 5999

[5]. A.N. Frone et al. Surface treatment of bacterial cellulose in mild, eco-friendly conditions, Coatings 8 (2018) 221

[6]. J. Liu et al. Development of nanocellulose scaffolds with tunable structures to support 3D cell culture, Carbohydr Polym 148 (2016) 259–271

INVITED SPEAKERS

Id-250

Nanobodies: Tiny Antibodies with A Huge Potential for Immunosensing

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Abstract: Camelids have a special type of antibodies that are devoid of light chain. Their antigen binging site is thus conformed exclusively by the variable heavy chain (VHH) and despite the reduced surface of their paratope they bind their targets with similar affinity than conventional antibodies. The recombinant VHH domain, also known as nanobody is only about 15 kDa and possesses remarkable properties that make them to stand out as affinity reagents for analytical applications. Nanobodies are easy to generate and select from phage display libraries and can be produced by bacterial fermentation with high yields. The self-folding nature of the VHH domain contributes to their solubility, thermal stability and tolerance to organic solvents. They can be genetically manipulated to adapt their performance to the specific immunosensing application, including the formation of chimeric tracers and their oriented immobilization by site-directed modifications. In this presentation different developments on their selection and applications will be discussed.

Keywords: Phage display, immunodetection, nanobodies, vhh

INVITED SPEAKERS

Id-259

Antibacterial Activity of ZnO and CuO Nanoparticles

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Abstract: Nosocomial infections significantly affect the human health and are responsible for high mortality rates worldwide. In this work we report the synthesis of ZnO and CuO metal oxide nanoparticles via sol-gel method. Antibacterial activity was performed on Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa bacteria using disc and well diffusion methods, bioluminescence and optical density analyses. The results show a strong decline of bacterial strains after a short contact with nanoparticles. The modelling allowed clarifying the bacterial sensitivity to toxic agents at different stages of their population evolution kinetics. It was concluded that the bacterial suppression is most effective at the exponential growth phase while it is of a lower effectiveness at the lag and stationary phases. The CuO and ZnO nanoparticles showed comparable effectiveness at the exponential growth phase This approach is used to select the best compromise between antimicrobial effectiveness and nanoparticles concentration for coating applications. We develop a synthesis of nanomaterials based on metal oxide nanoparticles in thin layers for surface decontamination.

Keywords: Antibacterial, Nanoparticles, CuO, ZnO, modelling

INVITED SPEAKERS

Id-260

Dental Biomaterials Studied By Atomic And Nuclear Surface Analysis Methods

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Abstract: New dental biomaterials are created at a high rate and in large variety. They are confronted with surface phenomena occurring at their interface with the oral tissues and environment, which produce degradation by corrosion, dissolution and wear. To improve their physical-chemical characteristics as well as their biotolerance, biocompatibility and osseointegration, nondestructive instrumental methods for the investigation of surface chemistry and physics are needed. Atomic and nuclear surface analysis methods qualify chiefly to this end. They reach unsurpassed sensitivity in elemental analysis and are unique by surface mapping at micrometer resolution and by depth profiling capabilities of layers 1 nm–100 μm thick; they can determinate the structure of thin layers and of micro- and nanometer defects in coatings. Some techniques can provide also chemical and electronic information and compound identification by analysis of molecular groups and fragments, of valence state, of chemical bonding and of coordination symmetry. Ion beam analysis (IBA) and X-ray spectrometry (XRS) methods are atomic and nuclear techniques which meet the above demands. All of them make use of incident and emergent beams of ionizing radiation and particles to analyze the specimen; basic principles and applications are discussed. Significant results were obtained by IBA and XRS characterization of the dental materials and of their changes in the oral environment [1]. A large variety of dental biomaterials have been investigated: hydroxyapatite (HA) and calcium phosphates, ceramics, glasses, polymers, chitosans, alginates, adhesives, composites, glass ionomers, endodontic materials, silver amalgam, dental alloys, titanium implants and their coatings. Remarkable advances single out the following lines of applications: 1) Metals released by corrosion and friction wear from dental amalgam, metallic restorations and implants of Ti (including porous Ti), contamination with Ti debris and TiO_2 from implants, metal diffusion in teeth; Ag_2S in aged amalgam. 2) Corrosion resistance of HA, bioceramics, oxide, nitride, Sr based- and phosphoric acid induced coatings of Ti implants, and of amorphous diamond-like carbon thin films. Non-uniformity and sub-nanometer pores of protective layers; hydrogen depth profile in amorphous carbon coatings and in steel. 3) *In vivo* diagnosis of metal allergies and oral tissues contamination with released metals. 4) Alterations of dental composites and glass ionomers during use; F distribution in F-releasing materials and in teeth; retention of F and mapping of Ca and F interdiffusion zone in the composite-tooth interface. 5) *In vivo* analysis of F in teeth

with external proton beam. 6) Laser-enhanced F retention at enamel surface; laser deposited HA and Ca phosphate films. 7) Resorbable and antimicrobian bioglasses dopped with Ti and Ga; biocompatible ceramics (HA, Ca phosphates, ZrO_2-Y_2O_3). 8) Adhesives; adhesion of composites and glass-ionomer cements to dentin and enamel; adhesion of silanized ZrO_2 granules to resin. 9) Organic coatings (with proteins, glycans) of dental materials; structure of HA-chitosans and alginates. The present survey evidences a substantial contribution of IBA and XRS methods in the field of dental biomaterials' development.

Keywords: Dental biomaterials, atomic and nuclear analysis methods

Referances:

[1]. E.A. Preoteasa, Elena S. Preoteasa, Ioana Suciu, Ruxandra Bartok, *AIMS Mater. Sci.*, 5(4): 781–844, 2018.

INVITED SPEAKERS

Id-264

Upconverting Nanoparticles for Biomedicine: The Dissolution Problematics and Possible Solutions

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Abstract: Upconverting nanoparticles (UCNPs) have been extensively studied primarily as alternative biomarkers in medical diagnostics but also in nanotheranostics and biosensors. The UCNPs are nanocrystals co-doped with Yb^{3+} and Er^{3+} or Tm^{3+} or Ho^{3+} ions Their property of interest is upconversion luminescence, i.e., the emission of higher-energy light after an excitation with the light of lower energy. In particular, Yb^{3+} ions are excited with near infrared (NIR) light (~980 nm), the energy is transferred to the emitting ions (Er^{3+} or Tm^{3+} or Ho^{3+}) that emit visible light and, in the case of Tm^{3+}, also NIR light (808 nm). As oppose to organic fluorophores, the UCNPs do not suffer from bleaching and autofluorescence. In addition, the possibility of excitation with NIR light allows for a deeper tissue penetration and limited tissue damage in comparison to classic fluorophores that are excited by ultraviolet light. The crystalline matrix significantly affects the UC luminescence intensity. This is because the UC process takes place via several energy-transfer events that compete with nonradiative (i.e., thermal) relaxation. Another factor affecting the luminescence intensity that is specific to NPs (due to their large surface-to-volume ratio) is surface quenching arising from the interaction of the Ln^{3+} ions with surface oxygen-based groups (e.g., H_2O, –OH). Moreover, the large surface of NPs makes them more reactive and less chemical stabile in comparison with the bulk of the same chemical composition and structure. Therefore, the surface chemistry of the UCNPs must me optimized to improve their stability, depending on a specific application. $NaYF_4$ co-doped with Yb^{3+} and Er^{3+} or Tm^{3+} are one of the most extensively studied UCNPs. $NaYF_4$ has low phonon energy and flexible structure allowing for a complete substitution of Y^{3+} with Ln^{3+}. However, we showed that fluoride UCNPs partly dissolve in aqueous media, specifically in the presence of phosphate ions [1]. Subsequent studies showed on a significant effect of the dissolution of UCNPs on their luminescent behavior [2]. In addition, different adverse effects on the cells can be expected [3]. One of the solutions is to protect the UCNPs with a waterproof coating that would prevent the interaction of the UCNPs surface with the water and dissolved species. The coating design should also provide for a colloidal stability in physiological media and biocompatibility. In this contribution we will present the dissolution mechanism and related problematics for the application of UCNPs. We will discuss the potential coating solutions and application possibilities in biomedicine.

Keywords: Upconverting nanoparticles, dissolution, luminescence, bioimaging

Referances

[1]. D. Lisjak, O. Plohl, J. Vidmar, B. Majaron, M. Ponikvar-Svet, *Langmuir*, **32** (2016) 8222.

[2]. S. Lahtinen, A. Lyytikäinen, H. Päkkilä, E. Hömppi, N. Perälä, Mika Lastusaari, T. Soukka, *J. Phys. Chem. C*, **121** (2017), 656; O. Ploh, M. Kraft, J. Kovač, B. Belec, M. Ponikvar-Svet, C. Würth, D. Lisjak, U. Resch-Genger, *Langmuir*, **33** (2017) 533; O. Dukhno, F. Pryzbilla, V. Muhr, M. Buchner, T. Hirsch, Y. Mely, *Nanoscale*, **10** (2018) 15904.

INVITED SPEAKERS

Id-271

Biosensor Technology for Point-Of-Care Testing

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Abstract: The growing interest of modern, innovative and effective analytical devices for detection, quantification and monitoring of specific chemical species is driven by the need of improvement in medical, industry and environment protection fields [1-3]. Biosensors represent a new trend in the diagnostic technology, because the devices join biological, chemical and physical sciences with engineering, and the use of enzymes was found to be very beneficial in their development [3]. Biosensors, as a hybrid of biological recognition element and chemical sensor are able for sensitive and specific determination of relevant molecules in the body fluids, which gives strong and effective possibility for early diagnosis and treatment of wide range of disorders [1-3]. In that case, biosensing platforms can be successfully used as a new device in the field of *Point-of-Care* (POC) testing. Detection of neurotransmitters (e.g. adrenaline, dopamine) is a foreground goal in case of early diagnosis of the neurodegenerative and psychiatric disorders. It is generally known, that level of dopamine and epinephrine is directly connected with development of such diseases as Parkinson, Alzheimer or schizophrenia. Due to the reason, rapid and sensitive analytical detection is essential in neurotransmitters testing. We report here the fluorescence-based sensor and biosensors for selective and sensitive epinephrine detection. A convenient fluorescence sensing procedure was developed and the ceramic-based miniature biosensor was designed and constructed through the immobilization of enzyme (laccase, tyrosinase) in an electrochemically synthesized polymer - poly-(2,6-di([2,2'-bithiophen]-5-yl)-4-(5-hexylthiophene-2-yl)pyridine), based on low temperature co-fired ceramics technology (LTCC). The detection procedure was based on the oxidation of substrate i.e., in the presence of the enzyme. An alternative enzyme-free system utilized the formation of a colorful complex between Fe^{2+} ions and epinephrine molecules. With the optimized conditions, the analytical performance illustrated high sensitivity, selectivity in a broad linear range with a detection limit of 0.14 – 2.10 nM (Fig.1). Moreover, the strategy was successfully used for EP injection test with labeled pharmacological samples.

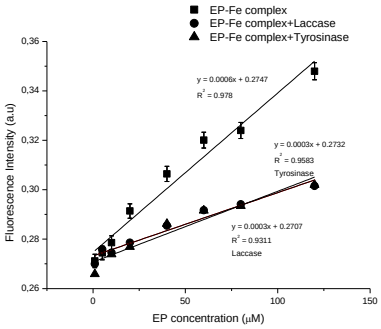

Fig. 1. Linear relationship between fluorescence intensity and EP concentration (1 - 120 μM) for sensor and biosensors (systems employing laccase and tyrosinase)

Keywords: Biosensore, neurotransmitters, point-of-care platform

Referances

[1]. Mahmoudi M., Anal. Chim. Acta (2016), 917, 85-92

[2]. Wang B., Chen M., Zhang H., Wen W., Zhang X., Wang S., Microchim. Acta (2017), 184, 3189–3196

[3]. Baluta S., Malecha K., Zając D., Sołoducho J., Cabaj J., Sens. Actuat. (2017), 252, 803 – 812

INVITED SPEAKERS

Id-275

Tissue Engenieering Aplication In Articular Cartilage

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Abstract: The cartilage is a specialized tissue located in the joints whose function is to resist and distribute mechanical loads, facilitate movement, and generate low friction between surfaces. The main problems of cartilage tissue engineering are to get a scaffold with god cell interaction, good transport properties since it is not vascularized, and to avoid fibrous tissue. The talk will describe the development of an electrospun scaffold for application in cartilage regenerative engineering. Based on polylactic acid and polycaprolactone, the surface was modified with plasma polymerized polypyrrole-Iodine (PPy-I), which aims to improve cellular interaction and to ease the adhesion of the protein aggrecan (AG), an important component of the extracellular matrix of native cartilage. The polymer scaffolds were produced by the electrospinning technique of with polymer solutions of PLA and PCL 12% (w/v) in chloroform. Distance from the collector was 20cm, voltage of 20kV and jet flow 2ml/h. Membranes surface was modified using plasma polymerization of pirrole with Iodine PPy-I. The operating parameters of the reactor were: 8cm electrode spacing, power of 20Watts, 1.2x10-1mmHg pressure. The coated substrates with PPy-I were immersed in a solution of aggrecan (AG) from bovine articular cartilage (Sigma Aldrich) for 24 hours. Subsequently rinsed with distilled water for 10 minutes and allowed to dry at room temperature in a vacuum desiccator for 24 hours. Samples were characterized by Fourier transform infrared spectroscopy (FTIR-ATR) and scanning electron microscopy (SEM). For in vivo culture, cells were obtained from an auricular cartilage biopsy using a New Zealand white rabbit and a cell expansion cultures, scaffolds were tested in vivo in the dorsal region and in the knee of a rabbit. Characterization of the scaffolds, and mechanical testing and histologial analisis of the new-tissue obtained are presented.

Keywords: Aggrecan; Cartilage; Electrospinning; Plasma polymerization; Scaffold

INVITED SPEAKERS

Id-279

Sensitive Bioassay for Detection of Biologically Active Microbial Toxins in Food

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Abstract: Food poisoning results from the consumption of contaminated food with pathogenic bacteria, viruses or fungi. The CDC estimates 48 million people get sick, 128,000 are hospitalized, and 3,000 die from foodborne diseases each year in the United States. Some types of bacteria such as Staphylococcus aureus, E. coli O157:H7 or Clostridium botulinum have the ability to produce family of toxins. The gold standard method for determining toxin activity is animal testing however, this expensive method suffers from poor reproducibility, low sensitivity, and also raises ethical concerns regarding the use of experimental animals. Immunological methods, such as ELISA have been developed but they are unable to differentiate between active toxin, which sickens consumers, and inactive toxin that did not pose a threat to public health. We developed an alternative to animal use for detecting biologically active Shiga toxin, *Clostridium botulinum* neurotoxins and Staphylococcal Enterotoxins. Staphylococcus aureus is a prevalent bacterial pathogen causing foodborne diseases that affect about a quarter million people every year in the United States. Pathogenesis is brought about, most notably, by virulence factors comprising some twenty-three different staphylococcal enterotoxins (SEs) produced by *S. aureus* and which are involved in food poisoning. These toxins affect the gastrointestinal tract, induce emesis, and activate the immune system. We utilized the superantigenic effect of SEs and used an *ex vivo* bioassay as an alternative to live animal testing. To avoid food matrix interference and attenuation of signal, we separated SEs from spiked food products by employing immunomagnetic beads that were coated with an anti-SEs antibody. This *ex vivo* method has more sensitive than the existing live animal testing methods. However, this *ex vivo* bioassay requires sacrificing of mice. To overcome this limitation, we established a cell based *in vitro* assay using a human $CD4^+$ T-cell line, for the quantitative detection of SEs. Incubation of SEs with human T-cells and Raji B-cells led to quantifiable and dose dependent secretion of IL-2. This novel cell-based assay is highly specific to biologically active SEs. This is the first demonstration of an alternative assay that completely eliminates the use of animals for quantitative detection of active SEs.

Keywords: Food poisoning, alternative to animal use, staphylococcus aureus

INVITED SPEAKERS

Id-280

Organic–Inorganic Hybrids Based on Bioactive Glass and Polycaprolactone As Bone Substitutes

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Abstract: The need for synthetic materials for bone repair arises from the limited availability of human-derived materials (allo- and xenografts), or the limited performance of animal-derived or biological bone substitutes and the associated risk of pathogen transmission and infection. Among promising synthetic bone substitutes, bioactive glasses (BG) offer unique properties for bone regeneration, such as the ability to bond firmly to hard and soft tissues and to release osteogenic dissolution products while being degraded, but their brittleness prevents them from being widely used in a number of applications. Combining BG with polymers into a true hybrid system is therefore an ideal solution to associate toughness from the polymer and stimulation of bone mineralization from the BG, while mimicking the hybrid structure of bone tissues. For dental applications where slowly resorbable implants are requested to primarily ensure mechanical support, polycaprolactone (PCL) is a polymer of interest due to its long-lasting behaviour in vivo. We have recently performed the sol-gel synthesis of organic-inorganic hybrids based on SiO_2-CaO BG and PCL owning a number of key features: 1) the incorporation of calcium ions, known to trigger bone formation and cellular activity, into the hybrid structure without the need of any thermal treatment, 2) appropriate morphologies mimicking the dual trabecular/cortical structure of bone tissues, based on an open-porous trabecular architecture with well-controlled and tuneable porosity regarding both pore and interconnection sizes, combined with dense regions resembling cortical bone, 3) the ability to incorporate dopants based on organic nutrients with osteogenic properties preserved thanks to a synthesis process fully conducted at ambient temperature. The performances of BG-PCL hybrids were compared against bovine bone, one of the current gold standard and most frequently implanted bone substitute. In particular, BG-PCL hybrids exhibit superior ability to induce cell differentiation and cellular-driven biomineralization *in vitro*, while outperforming bovine bone when implanted in critical-size mice calvarial defects. The rate of bone regeneration is even increased when doping hybrids with natural osteogenic organic (polyphenol-based) or inorganic (metal cation) elements, leading to a 100% increase in tissue regeneration. As a result, BG-PCL hybrids seem a perfect match for dental applications where a slowly resorbable but highly bioactive filling material is needed.

Keywords: Bioactive glass, organic - inorganic hybrids, scaffolds, bone substitutes, polycaprolactone PCL

INVITED SPEAKERS

Id-281

New Biomaterials Made from Natural Compounds

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Abstract: Natural biological compounds can be used in the preparation of a variety of new polymers, both soft and hard, for biomedical applications. Bile acids are natural amphiphilic molecules that exist in the gastrointestinal tract and help in the digestion of fat by the formation of micellar aggregates. Their facial amphiphilicity, acid-base properties and the ease of chemical modifications make them interesting candidates in the preparation of polymeric biomaterials, which are expected to exhibit better biocompatibility and bioacceptance. Soft hydrogels have been prepared and can be crosslinked through host-guest complexation. Such polymers showed self-healing properties. High molecular weight homo- and copolymers based on bile acids were synthesized via entropy-driven ring-opening polymerizations and were found to display tunable mechanical properties and heterogeneous degradation behavior. The polymers are amorphous in nature and some display interesting shape memory properties. Multi-shape memory copolymers and reversible shape memory materials have also been prepared through copolymerization. New star-shaped bile acid copolymers and amphiphilic glycopolymers have been made and have shown potential use for the encapsulation and release of drugs.

Keywords: Shape-memory polymers, glycopolymers, drug delivery

References

[1]. K. Wang, X.X. Zhu, "Two-way Reversible Shape Memory Polymers with Tunable Actuation Temperatures", *Macromolecules*, **50**, 8570–8579, 2017.

[2]. Z. Ma, Y. Jia, X.X. Zhu, "Glycopolymers bearing galactose and betulin: Synthesis, encapsulation, and lectin recognition", *Biomacromolecules*, **18**, 3812–3818, 2017.

[3]. A. Cunningham, M. Robinson, X. Banquy, J. Leblond, X.X. Zhu, "Bile acid-based drug delivery systems for enhanced doxorubicin encapsulation: Comparing hydrophobic and ionic interactions in drug loading and release", *Mol. Pharmaceutics*, **15**, 1266–1276, 2018.

[4]. K. Wang, X.X. Zhu, "Two-way reversible shape memory polymers containing polydopamine nanospheres: Light actuation, robotic locomotion and artificial muscles", *ACS Biomater. Sci. Eng*., **4**, 3099–3106, 2018.

[5]. Z. Ma, X.X. Zhu, "Core-crosslinked micelles made of glycopolymers bearing dopamine and cholic acid pendants", *Mol. Pharmaceutics*, **15**, 2348-2354, 2018.

INVITED SPEAKERS

Id-285

Novel Technologies by Photodynamic Therapy (PDT)

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Abstract: The possibility of using photochemical internalization (PCI) to enhance effects of the cytotoxic drug bleomycin is investigated, together with photophysical determinations and outlines of treatment for intravesical therapy on bladder cancer. *In vitro* experiments indicated that employment of PCI technology using the novel photosensitizer $TPCS_{2a}$® enhanced the cytotoxic effects of bleomycin in bladder cancer cells. Furthermore, experiments in an orthotopic *in vivo* bladder cancer model show effective reduction in both necrotic area and bladder weight after $TPCS_{2a}$ based photodynamic therapy (PDT). The tumor selectivity and PDT effects may be sufficient to destroy tumors without damaging detrusor muscle layer. Our results present a possible treatment strategy for non-muscle invasive bladder cancer, with intravesical instillation of photosensitizer and bleomycin followed by illumination through an optic fiber by using a catheter. Results from initial studies on PDT will also be presented, as well as results on the localization of different photosensitizers in cellular structures.

Keywords: Photochemical internalization, cytotoxic drug bleomycin, cytotoxic effects

INVITED SPEAKERS

Id-286

Development of Novel Additives Elaborated by Ultrafast Laser Process for Potential Applications in Biomedicine and Tissue Engineering

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Abstract: Driven by surface cleanness, unique physical and optical and chemical properties, bare(ligand-free) laser synthesized nanoparticles (NPs) are now in the focus of intensive researches for varieties of applications such environment, catalysis and biomedicine. Based on the interaction of ultra-pulsed laser beam in liquid ambiance (e.g., aqueous solution) with a solid target material or water powder dispersed, this process can lead naturally to the formation of spherical NPs with modulate physicochemical properties including diameter and size dispersion, surface chemistry free from any ligands and functionalization. For instance, we thus have demonstrated the possibility to elaborate ultraclean and extremely stable colloidal solutions of AuNPs and SiNPs with unique physicochemical properties for biomedical applications (*F. Correard et al, Int. J. Nanomed., 2014, 9, 54152*; *T. Baati et al, Sci. Rep., 2016, 6, 25400).* Moreover, the presence of high oxidation state on the NPs surface (AuO-, SiOx- with 0≤x≤2) promises efficient interactions with many biological materials (e.g., proteins) and other functions (e.g., Amine, -COOH) with manageable dissolution rate *(A. Al-Kattan et al, J. Mater. Chem. B, 2016, 4, 78523)*. As one of the major result, we have shown that SiNPs can be exploited as significant sensitizers of radiofrequency (RF)-induced hyperthermia on Lewis lung carcinoma with efficient tumor inhibition and without side effect at relative low concentration *(K.P. Tamarov et al, Sci. Rep., 2014, 4, 7034)*. Very recently we have also elaborated promising alternative plasmonic tools based on TiN NPs for potential photothermal therapy modalities *(A. Popov et al, Sci Rep, 2019, 9, 1194)*. Beside conventional additives mainly made-it by chemical way, we have also started to explore such bare laser synthesized NPs as novel functional additives for tissue engineering applications *(A. Al-Kattan et al, RSC Adv., 2017, 7, 31759; A. Al-Kattan et al, IJMS, 2018, 19(6), 1563).*

Keywords: Laser process, nanoparticles, theranostics, tissue engineering

INVITED SPEAKERS

Id-287

Enhanced FRET Probing with Directed Assembly of Bio-conjugated Semiconductor Quantum Dots

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Abstract: While Fluorescence Resonance Energy Transfer (FRET) has been shown to be an effective tool for probing target molecules or specific molecular interactions, actual FRET detections often suffer weak signals and long detection time due to low sample concentrations. In this talk, we demonstrate that FRET probing can be significantly promoted by overcoming the above shortcoming using bio-conjugated quantum dots (QDs) and proper sensor designs. Specifically, we employ QDs as FRET donors to probe single-stranded DNA (ssDNA) molecules labeled with fluorescent FRET acceptors. We show that the probing can be significantly boosted up by having QDs directly assembled or/and having them worked under AC fields. Several approaches are developed to demonstrate such enhanced FRET probing. In the first approach, we prepare a 1-D FRET sensor by lining QDs over a stretched double stranded DNA molecule (dsDNA). Because this design is able to promote diffusion of target ssDNAs toward the QDs, the measured FRET signals are found stronger than those using disperse QDs. Taking advantage of this wire-like geometry, we further show that the FRET signals can be made even more amplified by applying an AC electric field across the QD-dsDNA nanowire. In the second approach, we extend the first approach by trapping and stretching QD-conjugated dsDNAs using AC fields, and use this design to capture ssDNAs also under AC fields. Compared to the first approach, the FRET signals become even stronger. What is more, the FRET efficiency can reach as high as 70 % much greater than the theoretical value 10%. The third approach is direct trapping of QDs and ssDNAs using AC fields. We find that not only can the FRET signals be greatly amplified within 30 s after turning on an AC field, but also the FRET detection sensitivity can be pushed to an order of 0.1 picoM. This rapid and ultrasensitive FRET detection is identified to be a result of AC electro-osmosis (ACEO), dielectrophoresis (DEP), and field-induced dipole attraction (FIDA). Our findings show that making use of assembled QDs and AC electrokinetic effects can substantially strengthen FRET probing capability. This might open up a new avenue for more efficient and accurate medical screening and molecular assays at chip scales.

Keywords: Fluorescence Resonance Energy Transfer (FRET), quantum dot, electrokinetic effects

INVITED SPEAKERS

Id-289

Functionalization of Aliphatic Polyester Fibers Formed by Electrospinning - The Effect of Crystallinity on Aminolysis

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Abstract: The major drawback of aliphatic polyesters in tissue engineering applications is related to their poor hydrophilicity and the lack of reactive functional groups limiting interactions with cells. Various methods of surface modification followed by immobilization on the surface of bioactive molecules have been developed so far. One of the extensively studied methods of polyester surface modification is aminolysis which is characterized by attacking on the backbone ester bonds by diamine molecules at the interface between the diamine solution and polyester material, endowing the polyester surface with amino and hydroxyl groups which are the basis for subsequent conjugation of bioactive molecules. It is known that aminolysis is selective with respect to the state of supermolecular organization, being faster in amorphous than in crystalline phase. The objective of our work is to analyse the effect of crystallinity on aminolysis using various aliphatic polyesters. Three different aliphatic polyesters - poly(□-caprolactone) (PCL), poly(L-lactic acid) (PLLA), and copolymer PLA-PCL (70/30) (PLCL) in a form of nanofibers and films were investigated. Nanofibers were formed by solution electrospinning using hexafluoroisopropanol as a solvent while films were formed via solution casting method. Aminolysis was carried out using 6% w/v ethylene diamine in isopropanol solution at 30°C, at 5 and 15 minutes. Effectiveness of aminolysis was evaluated using ninhydrin test. Complementary information was obtained from ATR-FTIR and mechanical tensile tests. Crystallinity was determined from wide-angle X-ray scattering experiments (WAXS). The results of ninhydrin tests show that for PLLA and PLCL fibers the progress of aminolysis increases with time while for PCL fibers the aminolysis does not occur. Contrary to the fibers, for all investigated polymers in the form of film, including PCL, the ninhydrin test results indicates effective aminolysis. The results of ninhydrin tests are supported by FTIR results and by the stress and strain at break indicating molecular degradation for PLLA and PLCL which accompanies aminolysis. From WAXS analysis it is evident that crystallinity for PCL is higher than for PLCL, being 0,66 and 0,53, respectively, while PLA is practically amorphous (crystallinity 0,03). Similar relation between crystallinity was observed for films. It should be aware that the measured WAXS crystallinity is a bulk crystallinity and it is known from the conventional high speed spinning that the crystallinity at the fiber surface can be much higher than in the core due to faster solvent evaporation resulting in a radial gradient of polymer concentration [1]. There is no data on radial gradient structure in nanofibers so far, but there is no reason to expect that such gradient doesn't exist on smaller scale in electrospinning. Considering the effect of higher crystallinity at the surface of electrospun fibers, we

explain the problem with aminolysis of PCL fibers by a highly crystalline barrier formed at the surface, which slows down the diffusion of diamines and reduces the exposure of ester bonds. In the case of films, the structure gradient perpendicular to the surface is lower because of slower rate of solvent evaporation than for electrospun fibers.

Keywords: Nanofibers, polyesters, surface functionalization, aminolysis, structure

Acknowledgements: This work was funded by the Polish National Science Center (NCN) under the Grant No.: 2016/23/B/ST8/03409

References

[1]. Ziabicki A., Fundamental Scientific Problems in Ziabicki A., Kawai H., High-Speed Fiber Spinning, Science and Engineering Aspects, New York, John Wiley & Sons, 1985

REGULAR SESSIONS

Id-061

Hydrogel Microarrays as a Tool for Personalized Medicine in Present and Future

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Abstract: Biological microarrays (biochips) are analytical tools that are able to realize complex integrative genomic and proteomic approaches and to solve the problems of personalized medicine including examination of a patient in order to reveal the disease long before manifestation of clinical symptoms, an assessment of the severity of pathological or infectious processes, and a choice of rational treatment.The efficacy of biochips is determined by the ability to perform multiple parallel specific reactions and to study interactions of biopolymer molecules such as DNA, proteins, glycans, etc. One of the pioneers of the microarrays was the Engelhardt Institute of Molecular Biology (EIMB), suggesting an integrated technology based on the use of low-density microarrays comprised of hemispherical gel elements. Immobilization of molecular probes in 3D hydrogel pads provides some essential advantages compared with conventional flat surfaces. The structure of the gel can be adapted for immobilization of virtually any biological molecules in a natural hydrophilic environment. The discrimination between matching and mismatching duplexes of nucleic acids in these conditions is more reliable than on planar surfaces, minimizing the number of elements needed to detect specific sequences. Protein molecules immobilized in hydrogel-based biochips better preserve their biological properties. The universal platform of EIMB hydrogel microarrays served as a basis for development of applications for multiplex analysis of DNA and protein biomarkers of social diseases including molecular genetic, immunological, and epidemiological aspects of pathogenesis.The methods for detection of DNA of infectious diseases agents (tuberculosis, hepatitis C, infections of human reproductive system) with simultaneous genotyping and identification of genetic determinants associated with the response to antimicrobial or antiviral therapy have been developed, patented, and introduced into medical practice. Biochip-based tests for the detection of *Mycobacterium tuberculosis* resistant to first- and second-line drugs are successfully used in more than 30 anti-TB centers in Russia, and their clinical efficacy has been proven. Hydrogel biochips serve as a core for assays based on multiplex immunochemical analysis. A multiplex assay for the simultaneous quantitative detection of 44 sIgE and sIgG4 has been developed. Testing of more than 2000 serum samples from patients with allergy and healthy donors proved the efficiency of using allegro-biochip for diagnosing of I type hypersensitivity. Simultaneous analysis of protein serological tumor markers and antibodies to tumor-associated glycans in blood serum samples of patients allows detection of colorectal cancer at the early stages with high diagnostic sensitivity and specificity. In the extremely competitive environment of the molecular diagnostics market, biochips

consisting of 3D hydrogel elements occupy a unique position. They are fully versatile and have an opportunity for the development of new generation portable biosensors. The hydrogel elements can become a platform for the joint immobilization of genome editors - Cas13a/Cas12a nucleases together with the guide and reporter RNA/DNA molecules. Programmable nucleases operation, supplemented with isothermal amplification, will allow the development of highly sensitive CRISPR-based hydrogel biosensors. Such point-of-care systems will provide results faster, more informative and accurate than at present, and will play a key role in the personalized medicine of the future.

Keywords: Hydrogel Microarrays, Biosensors, Nucleic Acids Hybridization, Multiplex İmmunochemical Analysis, Antimicrobial Drug Resistance, Genotyping, Tumor Markers

REGULAR SESSIONS

Id-119

Removal of Cannabis Metabolite from Human Urine in Microbial Fuel Cells Generating Electricity

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Abstract: Electricity was generated directly from synthetic or human urine containing 11-nor-9-carboxy-Δ^9-tetrahydrocannabinol in air-cathode microbial fuel cells. Synthetic urine contained sodium acetate as carbon source, while actual urine was used neat, without further supplements. Microbial fuel cells were capable of degrading more than 60% of the cannabis metabolite from human urine, while generating electricity. With synthetic urine, voltage generation reached 0.33V, however the addition of 300 ng/mL of 11-nor-9-carboxy-Δ^9-tetrahydrocannabinol decreased the peak voltage to 0.27 V. This loss in power generation was nevertheless reversible when 11-nor-9-carboxy-Δ^9-tetrahydrocannabinol was removed from the media. Real urine containing 170 ng/mL 11-nor-9-carboxy-Δ^9-tetrahydrocannabinol produced 0.23V of continuous electricity in the microbial fuel cells. The mechanism for degradation of cannabis metabolites in microbial fuel cells was discussed according to the results of the computational studies. In conclusion, wastewaters contaminated with urine-based cannabis metabolites could be treated in microbial fuel cells along with voltage generation as added-value.

Keywords: Cannabis; COOH-THC; Electricity; Human Urine; Microbial Fuel Cell; Wastewater

REGULAR SESSIONS

Id-121

Fluorescent Gold Nanoclusters with Tunable Optical Features: Synthesis, Characterization and Selective Detection of Biomolecules in Aqueous Medium

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Abstract: Gold nanoparticles (Au NPs) and gold nanoclusters (Au NCs) having characteristic plasmonic or highly photoluminescence features have become one of the most important types of nanomaterials that have been extensively investigated in many fields. The sub-nanometer sized Au NCs show unique physical and chemical properties such as well-defined molecular structure, discrete electronic transitions and characteristic size- and structure-dependent tunable photoluminescence. Most of the protein-stabilized Au NCs exhibit intense red photoluminescence ($\lambda_{emission}$ ~ 650 nm) which originates from the icosahedron gold core and partially independent from the applied protein. In this work presented here, we highlighted the green syntheses of biocompatible Au NPs and Au NCs using proteins (bovine serum albumin (BSA); lysozyme (LYZ), gamma-globulin (γG)), nucleotide (adenosine monophosphate (AMP) and amino acids (histidine (His); tryptophan (Trp), cysteine (Cys) which result in different nanostructures having tunable blue, green, yellow and orange emissions [1-3]. The main goal of this work was to investigate the spontaneous interactions of $AuCl_4^-$ and the studied biomolecules as well to optimize the gold/biomolecule ratios and pH on the formation of gold nanosized objects. Based on the experimental results we provided important information on the gold intermediates and the formation mechanisms of the plasmonic or fluorescent NPs and NCs. Moreover, the fluorescent Au NCs were used for selective detection of different transition metal ions (e.g. Fe^{3+}), anions and small molecules in aqueous solutions. In the human body, the one of the major catabolic route of $_L$-Trp is the kynurenine pathway (KP), which has an important role in several vital processes. The intermediate molecules of this metabolism show neurotoxic or neuroprotective features. The discrepancy in the concentrations of these molecules from the standard values contributes to the emergence of many neurodegenerative or psychiatric dysfunctions such as Alzheimer or Huntington diseases, amyotrophic lateral sclerosis (ALS) or schizophrenia. For this reason, the strict monitoring of the KP is of the paramount importance in medicine.

Keywords: Guided-mode resonance, subwavelength structure, bandstop filter, grating

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References

[1]. V. Hornok, E. Csapó et al. Colloid and Polymer Science, 294 (1) (2016) 49.

[2]. E. Csapó, D. Ungor et al. Coll. Surf. A, 511 (2016) 264.

[3]. D. Ungor, E. Csapó et al. Coll. Surf. B. 155 (2017) 135-141.

[4]. E. Csapó, D. Ungor et al. Coll. Surf. A, 532 (2017) 601-608

REGULAR SESSIONS

Id-123

Polyoxometalates as Sensors of Bacterial Activity

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Abstract: Polyoxometalates (POMs) have attracted a lot of attention due to their applications in materials science. Their structures are described as molecular fragments of metal oxides with the general formula $[X_xM_mO_y]^{n-}$ (where M = Mo, W, V, *etc*. and X = P, Si, As, *etc*.). Some POMs exhibits electrochromic properties. They have the ability to accept electrons yielding colored mixed-valence species. Living organism can act as electron donors to POM, so that the chromic properties of POM can be directly related to a certain biological activity, i.e., to life itself. Based on this idea, we have designed two different simple and low cost tests for bacterial activity. Firstly, it is possible to evaluate the reducing activity of *L. fermentum* through reactions with an electrochromic polyoxometalate, $[P_2Mo^{VI}_{18}O_{62}]^{6-}$, which changes from pale yellow to dark blue when reduced. We demonstrate that the reducing activity of *L. fermentum* correlates to its metabolic strength. Hence, the method can be used to assess the effect of some different drugs on this probiotic. In particular, the effects of omeprazole and vancomycin were evaluated against the viability of the probiotic *L. fermentum*. Omeprazole is commonly used for treating ulcers and gastritis, while vancomycin, is one of the more widely used of all antibiotics. We have resolved the controversy over the effect of these drugs on bacterial flora. Our results show that omeprazole has no effect on the reducing capacity of *L. fermentum*, and in consequence to its strength. However, vancomycin severely decreased *L. fermentum's* reducing capacity, leading to death or serious damage in this strain [1].In addition, we have developed a sensor for the diagnosis of bacterial vaginosis (BV) based on the theory that inhibition of the bacteria's metabolic activity reduces metabolite secretion. BV infections affect approximately 10-15% of women in the general female population. In BV, the typical vaginal flora consisting of lactobacillus bacteria, which secrete lactic acid into the media, are altered by the growth of pathogenic anaerobic bacteria, which secrete short-chain fatty acids, where acetic acid is the most abundant. Current diagnostic methods are based on sample gathering to detect the presence of potentially pathogenic bacteria, which requires time, is expensive and difficult. Here we have developed a diagnostic method based on the detection of the metabolites typically secreted by the bacteria. The POM, phosphomilibdic acid hydrate (PMA), which changes from yellow to blue when reduced in a sample containing lactic acid, is used to indicate the state of the vaginal flora. A more intense blue colour equals a higher concentration of lactic acid and, therefore, the "healthier" the sample

is. This test is highly accurate and precise, it provides a rapid diagnosis of the infection and can also be used to monitor treatment efficiency [2].

Keywords: Polyoxometalates, Sensors, Bacterial Metabolites, Bacterial Vaginosis

References

[1]. González, A. *et al*. Chem. Commun. 2015, 51, 10119-10122.

[2]. González, A. (2018). *Materiales bioinspirados basados en bacterias. Aplicaciones biomédicas* (Doctoral dissertation, Universidad de Granada).

REGULAR SESSIONS

Id-126

Enhancement of Sensıtıvıty in Measurement of Small Molecules by Surface Acoustıc Wave Immunobıosensors

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Abstract: Although chromatographic methods have been widely used in the detection of small molecules for many years, they require laboratory based high cost devices and trained users. For this reason, there is a need for diagnostic systems that can enable fast and on site detection with high sensitivity. Biosensors are considered as the most suitable candidates to meet this need.

As receptor affinity-dependent designs and antibodies are frequently used in biosensors. The immunobiosensor systems using antigen-antibody complexes as receptor are preferred quite oftenly due to their excellent sensitivity, affinity and specificity. In antibody based systems, affinity and aviditiy of the antibody has great impact on the sensitivity of sensor. Especially while working with small molecules, increasing the avidity significantly contributes to the sensitivity because of less steric constraints. To further reduce the steric and conformational constraints in increasing the avidity, dendrons are thought to be a suitable platform because of its conformational elasiticity.

In this study, we focused on increasing avidity with dendrons for the enhancement of sensitivity in measurement of small molecules by antibodies. Aflatoxin B1 (AFB1), which is a mycotoxin and is known for its carcinogenic properties, was used as model molecule. Phase shift measurements depending on capture of analyte by receptor were made by using love wave surface acoustic wave platform (AWSensors, A20F20, Spain). In this context, for the covalent immobilization of AFB1 to the sensor surface, primarily 11-mercapto-1-undecanol (MUD) was coated. AFB1-oxime was generated by reacting with AFB1 O-carboxymethyloxime and then immobilized on the sensor surface in the presence of EDC/NHS. Measurements were performed with a competitive immunoassay principle, which included the application of anti-AFB1 antibody D12E2 and AFB1 containing sample to the surface by mixing. In this method of measurement, it is expected that in the presence of AFB1, the D12E2 antibody will be bound to the surface at a lower rate and the measured change in phase shift will decrease. The affinity/avidity value expressing the antibody's binding power to the antigen significantly affects the sensitivity of the system. For this reason, the D12E2 antibody was conjugated with Polyester bis-MPA dendron 32 hydroxyl 1 amine-generation 5 (PBM321) to increase the avidity of the antibody and thereby improve the measurement sensitivity. As a result of measurements performed with conjugated and unconjugated D12E2, the detection limit was decreased by 1250 times from 250 ppt to 0.2 ppt. Such a

great improvement in the detection limit is thought to be due to the synergistic effect of increase in weight, the increase in avidity and k_{on} value as well as decrease in ko_{ff} value The results obtained from this study suggest that conjugation with Dendrons, which can be used as flexible antibody platform can be used for enhancement of sensitivity by combining the positive effects of mass and avidity increase instead of nanoparticle conjugation which is frequently used in weight-based biosensors and which does not provide flexibility to the antibody.

Keywords: Antibody, dendron, surface acoustic wave, avidity

REGULAR SESSIONS

Id-146

Photoreactive Hybrid Films with Tunable Wetting Properties

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Abstract: In recent years, superhydrophobic surfaces with water contact angle (WCA) higher than 150° have received considerable attention due to their significant potential for practical applications ranging from self-cleaning surfaces [1]. The second class of self-cleaning surfaces is photocatalytic coating which can chemically degrade organic materials when exposed to light [2,3]. During the photocatalytic process the irradiated photocatalyst particles produce highly reactive oxygen species and due to these formed reactive radicals the photocatalyst particles can degrade many organic compounds.

The main goal of our present work was to synthetized hybrid thin films with superhydrophobic and photoreactive dual properties. The Ag-TiO_2 photocatalyst particles were shown photocatalytic properties under LED-light irradiation. The structure and morphology of the synthesised Ag-TiO_2 / fluoropolymer hybrid thin films were examined by SEM- measurements. According to our experiments the structure of the thin films becomes more and more structured and roughened with the increasing Ag-TiO_2 nanocomposite content. The surface wettability of Ag-TiO_2/fluoropolymer hybrid layers was determined by the measuring of water contact angle (WCA) values on the solid surfaces. The surface roughness of the low surface energy flat fluoropolymer layer was enhanced with the Ag-TiO_2 nanocomposite. The photocatalytic activity of the prepared hybrid thin films was verified with ethanol, benzoic acid and Bovine serum albumin (BSA) photodegradation tests. which was measured under LED light illumination (λ_{max} = 405 nm). The photooxidation measurements for etanol were determined by gas chromatography (Shimadzu GC-14B) under LED light illumination (λ_{max}= 405 nm) at S/G interface. Benzoic acid and BSA photodegradation tests was measured under UV-A (λ_{max}= 365 nm) illumination at S/L interface.

The hybrid layers consist of ~25 μm layered double oxide (LDO) photocatalyst particles with dual photocatalytic and water- repellent properties were also exposed to bacterial suspension of *Escherichia coli* (Gram negative), *Staphylococcus aureus* (Gram positive) and *Pseudomonas aeruginosa* (Gram negative). The bacterial adhesions were quantified by measuring the optical density of absorbed crystal violet by adhered cells after exposure to LDO particles containing surfaces. The results showed that surface- roughness influenced wetting properties of the hybrid layers and they have an important role on the bacterial adhesions. The bacteria prefer to adhere on the surfaces with higher roughness containing at least 80% of LDO in the polymer matrix.

Keywords: Hybrid Films, Superhydrophobic Surfaces, Photodegradation, Bacterial Adhesions

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References

[1]. Á Deák, L. Janovák et al., Applied Surface Science. 389, 294 (2016).

[2]. Sz. P. Tallósy, L. Janovák, J. Ménesi et. al., Environ Sci Pollut Res, 21, 11155 (2014).

[3]. Á. Veres, J. Ménei, L. Janovák, et. al., Colloid Polym Sci, 292, 207-217 (2013).

REGULAR SESSIONS

Id-150

Designed Composites Thin Films and Nanoparticles: From Bio- Inspired Self-Cleaning Surface to Stimuli Responsive Functional Materials

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Abstract: The basic principle of polymers, that is multiple assemblies of simple structural units for the formation of a two- or three dimensional construct, has wide distribution in different applications from intelligent material to controlled drug delivery [1]. Man-made synthetic or modified biopolymers are almost as manifold as the natural ones, newly developed polymers rapidly entered different uses, such as biomedical applications. The different polymer filler materials are often used for the improvement of the initial polymers' behaviours. Polymer blends and composites became a central part of polymer science and engineering because people could make compositions that had properties substantially unattainable with homopolymers and statistical copolymers. Such properties include greater toughness and impact resistance, higher modulus, higher use temperature, broader temperature range of sound and vibration damping, etc [2]. In this work we implemented the synthesis of photoreactive hybrid thin layers with polymer hydrophilicity tailored tunable wetting properties from superhydrophilic to superhydrophobic nature [3]. The incorporation of photocatalyst nanoparticles into the polymer matrix was ensured the adequate surface roughness of the polymer layer. At solid/ liquid interface the photocatalytic efficiency was depend on the polarity of the used model pollutants [4]. It will be also presented that the modification of the initial chitosan biopolymer resulted pH-responsive intelligent drug release system suitable for the encapsulation and pH-mediated drug delivery of poorly water soluble Ca^{2+} channel blocker nimodipine drug molecules. According to the in vitro experiments carried out under physiological condition, the developed NPs were released relevant drugs to the site of evolving ischemic injury (pH < 6.9) [5].

Keywords: Polymer composites, adjustable hydrophilicity, tailored wetting, pH- induced drug delivery

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References

[1]. M. F. Maitz, Biosurface and Biotribology, 1 (3), (2015), 161-176.

[2]. L. H. Sperling, Applied Polymer Science: 21st Century (2000), 343-354.

[3]. L. Mérai et. al., eXPRESS Polymer Letters, 12, 12 (2018) 1061–1071.
[4]. L. Mérai et. al., Catalysis Today (2018) https://doi.org/10.1016/j.cattod.2018.10.015
[5]. L. Janovák et. al., European Journal of Pharmaceutical Sciences 123 (2018) 79–88

REGULAR SESSIONS

Id-155

Promoting Angiogenesis Phenomena Using Magnetic Scaffolds

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Abstract: Cardiovascular disease is a leading cause of death in the developed world, representing 31% of global deaths every year [1], thus creating a demand for novel treatment options. However, a major challenge in cardiac tissue regeneration is the ability to promote adequate vascularization to support cell and tissue growth, function and viability [2]. The paracrine signaling mechanism associated with mesenchymal stromal cells (MSCs) has been identified in the regulation of key biologic processes both *in vitro* and *in vivo* [3], through angiogenic factors such as the Vascular Endothelial Growth Factor-A (VEGF-A). This study presents the effect of external magnetic fields of low intensity in controlling the secretome of bone marrow MSCs culture, specifically targeting the control of vascularization. The external magnetic field is also used as trigger to control biomaterial MSCs interactions. To reach this proposal two different magnetic scaffolds were developed: Polyvinylalcohol (PVA) and Gelatin. The MSCs capacity to secrete VEGF-A was modulated when cultured on the scaffolds under the application of a magnetic field. PVA scaffold promotes low MSC adhesion and thus the formation of cell aggregates, showing a decreased *VEGF-A* expression up to 4-fold under magnetic field stimuli. On the other hand, in the gelatin scaffold, it was observed a migration of the cells into the matrix. When exposed to the magnetic field, the encapsulated cells expressed increased values of *VEGF-A* expression with a 5-fold change. These results were complemented with VEGF-A protein quantification of the collected conditioned media and sprouting functional assay of endothelial cells (HUVECs), which provided significant results to prove our concept. *Ex-vivo* assay Chick Chorioallantoic Membrane (CAM) studies were carried out to provide additional insights on the formation of new vascular structures. In the future these studies could provide new insights into disease mechanisms and drug discoveries, leading to an improvement of biomaterial revascularization and the overall clinical applicability of tissue engineering.

Keywords: Scaffolds MesenchymalStemCells MagneticFields Angiogenesis

References:

[1]. World Health Organization, Cardiovascular disease, accessed 30 November 2018, <http://www.who.int>

[2]. Lovett M., Lee K., et al., Vascularization Strategies for Tissue Engineering, Tissue Engineering. Part B, Reviews, 2009, 15(3): 353-370.

[3]. Gnecchi M., Danieli P., et al., Paracrine Mechanisms of Mesenchymal Stem Cells in Tissue Repair, Methods Mol. Biol., 2016, 1416: 123-46.

REGULAR SESSIONS

Id-160

Chemical Comparison of Different Graft Materials by Energy Dispersive X-ray Spectrometry Technique

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Abstract: Dental grafts can function between two vital structures, such as tooth and bone tissue, and can provide an osteoconductive effect between nonvital structures such as dental implant and alveolar bone. The physicochemical properties of dental graft materials are very important because they strongly influence the bone regeneration capabilities of biomaterials. The purpose of this study is to investigate the chemical composition and surface energies of white (WPTG) and black porous titanium granules (PTG), bovine bone graft and equine-derived bone graft through energy dispersive X-ray spectrometry (EDX) analysis to the comparison**.**The surface chemical compositions of PTG, WPTG, bovine bone graft, and equine-derived bone graft were measured by EDX analysis. All graft materials' morphologic characteristics such as particle and granule dimension, porosity degrees, micropore measurements were evaluated with Scanning Electron Microscopy (SEM). The EDX measurement of samples were evaluated at x250, x2000 x5000 magnification. PTG grafts showed elements of sodium (%8.88±9.98), chlor (2.44±1.96) and aluminum (0.99±0.37) as well as titanium (90.06±11.34) molecule at x5000 magnification. In WPTG, titanium (%34.55±6.41) and oxygen (%65.44±6.42) molecules were detected. EDX analyses have detected the presence of sodium, calcium, and phosphorus in equine-derived and bovine bone graft. It has been found that PTG surface was not made of pure titanium, it has different chemical molecules at larger magnifications and xenografts exhibited different organic material content. Cell culture and experimental studies are needed to establish a relationship between the different commercial dental grafts and their regenerative properties.

Keywords: energy dispersive x-ray technique; surface composition, scanning electron microscopy, bone substitute

REGULAR SESSIONS

Id-172

Transparent Biopolymer Antioxidant Films for Controlled Release

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Abstract: Polyvinylpyrrolidone (PVP) is probably one of the most utilized pharmaceutical polymers with applications ranging from blood plasma substitute to nanoparticle drug delivery, since its synthesis in 1939. It is highly biocompatible, non-toxic and transparent film forming polymer. Although high solubility of PVP in aqueous environment is advantageous, it still poses several problems for some applications in which sustained targeting and release are needed or hydrophobic drug inclusion and delivery systems are to be designed. In this study, we demonstrate that a common dietary phenolic antioxidant, *p*-Coumaric acid (PCA), can be combined with PVP covering a wide range of molar ratios by solution blending in ethanol, forming new transparent biomaterial films with antiseptic and antioxidant properties. PCA not only acts as an effective natural plasticizer but also establishes H-bonds with PVP increasing its resistance to water dissolution. PCA could be released in a sustained manner up to a period of 3 days depending on PVP/PCA molar ratio. Sustained drug delivery potential of the films was studied using methylene blue and carminic acid as model drugs, indicating that the release can be controlled. Antioxidant and remodeling properties of the films were evaluated *in vitro* by free radical cation scavenging assay and *in vivo* on murine model, respectively. Furthermore, the material resorption of films was slower as PCA concentration increased, as observed by full-thickness excision *in vivo* model. Finally, the antibacterial activity of the films against common pathogens such as *Escherichia coli* and *Staphylococcus aureus* and the effective reduction of inflammatory agents such as matrix metallopeptidases were demonstrated. All these properties suggest that these new transparent PVP/PCA films can find a plethora of applications both in food and pharmaceutical sciences including skin and wound care.

Keywords: Antioxidants, Polyvinylpyrrolidone, P-Coumaric Acid, Wound Model

REGULAR SESSIONS

Id-191

Artificial Neural Network for the Smart SERS-Based Biosensing: a Case of UV-Induced DNA Damage

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Abstract: SERS is considered as one of the most attractive approaches for biosensing due to the high sensitivity, specificity, and simplicity of analysis [1]. Despite the excellent potential of SERS spectroscopy for monitoring analytes, certain critical challenges limit it application: low reproducibility, selectivity in complex biosamples and difficulties in interpretation of results [2]. Artificial neural network (ANN) is revolutionary automated pattern recognition tools, which have been already used not only for automatic driving, image recognition, speech recognition and translation, but also for the prediction of drug activities, gene mutations and diseases [3]. In this work a combination of two effective methods - SERS and ANN - is designed to detect changes in biosample as exemplified by UV-induced DNA damage using a portable Raman spectrometer and advanced mathematical algorithms. The plasmon-polariton supporting gold grating was grafted with oligonucleotide via diazonium chemistry and for further hybridization probe oligonucleotide was irradiated under UV light for various time periods (1-24 hours). After hybridization with damaged oligonucleotide, a massive of SERS spectra was collected and analyzed by ANN. The part of measured spectra was used for the deep machine learning of developed ANN and the second part of obtained spectra were given to the ANN for the analysis. Results demonstrate perfect convergence of predicated irradiation time up to 99%. One of the most important feature is possibility to recognize the area of interest form SERS spectra. We found that the majority of changes in SERS spectra are attributed to the change in thymine and cytosine structure due to the formation of dimer structures, described before. It should be noted that proposed method does not require complicated sample preparation or DNA labeling and it is time-saving and accurate compared to other widely used methods.

Keywords: SERS, Gold Grating, Surface Modification, Artificial Neural Network, DNA

References

[1]. Guselnikova, O.; Postnikov, P.; Erzina, M.; Kalachyova, Y.; Svorcik, V.; Lyutakov, O. Sens. Act. B 2017, 253, 830-838.

[2]. Yuanac, Y.; Lina, Y.; Gub, b.; Panwarb, N.; Chuan, S.; Jun, T.; Junle, S.; Yong, K.-T. Coord. Chem. Rev. 2017, 339, 138-152.

[3]. Wei, J. N., Duvenaud, D., & Aspuru-Guzik, A.ACS central science, 2016, 2(10), 725-732.

REGULAR SESSIONS

Id-217

Organic-Inorganic Hybrid Materials for Bone Tissue Engineering

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Abstract: Search for materials, which could serve as precursors of new „active" bio-fillers or coatings with specific and easy-to-modify properties is a very attractive research subject in the area of modern materials chemistry. Most of such materials belong to a group of organic polymers (polyurethanes, epoxy resins or polyethylenes) or pure metals. However, the latter are sputtered on a surface (in case of coatings) with the use of usually expensive and technologically complicated methods. Also modern bio-engineering - from materials perspective - is dominated by organic composites which are usually UV-cured and base on functionalized methacrylates. Nevertheless, their biocompatibility has always been a problem since the cytotoxicity of such materials is usually high. In search for a new material, we have developed a series of organic-inorganic hybrid materials based on sol-gel process. The materials are often utilized as EtOH solutions, what causes that they are hydrophilic and well penetrate the bone canals. They are doped with natural hydroxyapatite which induces its growth causing natural remineralization. The materials were proven to be fully biocompatible and cure at body temperature with no UV-light, but they might as well be designed as UV-cured.

Keywords: Biomaterials, Bone Repair, Sol-Gel, SEM, Biocompatibility

REGULAR SESSIONS

Id-220

Hyaluronic Acid-Cyclodextrin Crosslinked Nanofibers for Biomedical Applications

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Abstract: Hyaluronic acid (HA), a polysaccharide naturally found in the human body is crucial for many cellular and tissue functions and has been used in medicine for decades. The formation of biomimetic scaffolds by the electrospinning of HA have been actively studied, but its ionic nature poses some limitations to the electrospinning process. Consequently, HA is often dissolved in organic solvents or mixtures to promote the formation of nanofibers, which could raise toxicity issues and a limitation for use in biomedical application. A HA-based nanofibrous scaffold was successfully fabricated by electrospinning, using exclusively water as a solvent. enabling the development of safe functional wound dressings. Suitable blending with a template polymer and a modified cyclodextrine (hydroxypropyl-β-cyclodextrin: HPβCD) allowed us to easily electrospinning this polysaccharide and thereby providing fibers in nanometer range (100-500 nm). HPβCD is a compound of interest by its ability to encapsulate hydrophobic molecules, but we also demonstrated its role as a processing aid in fiber formation.

For medical purposes, the pre-formed mats require to be treated to exert water resistant feature. Crosslinking conditions (addition stage, concentration and annealing time) were investigated and then optimized using N-(3-Dimethylaminopropyl)-N′-ethylcarbodiimide hydrochloride (EDC) as biocompatible crosslinking agent. To validate the encapsulation properties of embedded HPβCD, nanofibers with HPβCD complexed with small molecules with anti-inflammatory properties (Naproxen) were produced. Naproxen could be impregnated into the membrane either in aqueous solutions or under supercritical CO_2, a promising new method of functionalization. Finally, the release kinetics of the active compound was characterized for these obtained functional fibers. The use of biocompatible products and the absence of harmful solvents make this nanofibrous scaffold a material of choice for biomedical applications in tissue engineering or wound healing. Furthermore, the combination of intrinsic characteristics of the HA and encapsulating properties of the HPβCD enabled the development of a bioactive material.

Keywords: Nanofibers, Biomedical, Electrospinning, Polysaccharide

REGULAR SESSIONS

Id-222

Tissue-engineered structures with a nanocarbon scaffolds for regeneration of the cardiovascular tissues

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Abstract: Myocardial infarction is one of the most harmful diseases of the cardiovascular system. Effective treatment is aimed at creating a 3D scaffolds that filled with living cells and implanted in the desired area. One of the most effective ways to create such scaffolds is 3D laser printing. The aim of the work is the creation of stratified tissue-engineered structures by the method of laser structuring of the nanocarbon scaffold in bioorganic matrices. The fibers from single-walled carbon nanotubes used to form the scaffolds. Carbon nanotubes have excellent mechanical, thermal and electric properties. Nanotubes have sizes close to those of the main components of the natural cell matrix, while their mechanical properties are similar to those of protein structures. Aqueous dispersions of nanocarbon fibers (concentration of 0.001 wt.%), proteins albumin (25 wt.%) and collagen (1wt.%) and aminosugar chitosan (2 wt.%) were used as the initial medium to print tissue-engineered structures. The model of a stratified tissue-engineered structure was constructed using the molecular dynamics method. The dependences of the interaction energy between the nanocarbon scaffolds and molecules of protein and aminosugar are investigated depending on the time of contact formation. Energy characteristics of laser radiation for the formation of the voxel structure were calculated theoretically (up to 0.1 J/cm^2). Printing of tissue-engineered structures was carried out using the developed laser setup, generating pulsed laser radiation. The initial aqueous dispersion was dosed into a Petri dish. Next, the laser radiation operated by scanning system was moved along the dispersion layer. The trajectory of the focused radiation was given by a computer model. As a result, a series of layers based on aqueous dispersions were formed. Using IR and Raman spectroscopy, the functionalization of nanocarbon fibers with carboxyl groups by proteins and aminosugar molecules was proved. It was established that nanocarbon fibers bind to Asp and Glu amino acid residues through oxygen atoms. Confocal microscopy proved the meshwork of tissue-engineered structures. The cell size was 100x100 μm. The internal scaffold nanostructure was investigated using SEM. It was found that the diameter of nanocarbon fibers increased by several dozens of nm due to their wrapping by a bio-organic matrix. The electrical conductivity of tissue-engineered structures exceeded the electrical conductivity of heart tissue and reached ~ 8.5 S/m. Mechanical characteristics of structures withstand stresses to which heart tissue is subjected: 20 kPa at the beginning of diastole and 500 kPa at the end of diastole. The proliferation of fibroblasts and endothelial cells on the structure's surface was demonstrated using fluorescence microscopy and MTT

assay. The density of proliferating cells on tissue-engineered structures was 33% higher than in control samples. Using AFM and SEM, the structure of cells that proliferated on the control sample and on the printed structure after 24, 48, and 72 hours were compared. The rate of tissue-engineered structures biodegradation during the implantation to laboratory animals was 95-110 days.

Keywords: Cardiovascular tissues, 3D scaffolds, nanocarbon fibers, laser structuring, living cells

POSTER SESSIONS

Id-062

Peptide-Induced Aggregation of Glutathione-Capped Gold Nanoclusters: A New Strategy for Designing Aggregation-Induced Enhancement Emission Probes

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Abstract: Most of thiolate-protected AuNCs have relatively low quantum yield (QY) of <1% and low molar extinction coefficient. This weakness makes the AuNCs suffer from low analyte-to-background ratios in in vitro and vivo imaging and sensing. Accordingly, strategies for boosting QY of thiolated-protected AuNCs are in urgent need, especially for the detection and imaging of low concentration of target analyte.In response to this request, several researchers have taken a variety of approaches to the QY of thiolate-protected AuNCs, which can be mainly classified into the following three categories: (1) tailoring of the AuNCs with suitable capping ligands to tune ligand to metal charge transfer process, (2) doping of the AuNCs with metal ions to adjust the metal composition, (3) aggregation-induced emission (AIE) and AIE enhancement (AIEE) and of thiolate-stabilized AuNCs. Since AIE- and AIEE-type AuNCs offer the distinct advantages of easy to handle, tunable QY, switchable PL, and controllable particle size, they are frequently implemented in the fields of optical sensors, light-emitting diodes, in vitro and vivo imaging, and drug delivery. Polymer and metal ion-induced AIE and AIEE of the AuNCs were exemplified by poly(allylamine hydrochloride), chitosan, polyetherimide, Gd(III), Cd(II), Pb(II), Ag(I), Ce(III), and Zn(II). In the procedure concerning AIE and AIEE, the AuNCs are initially synthesized via the reduction of gold ion precursor in the presence of capping ligands. The AuNCs are composed of a metal core protected by a layer of Au(I)-thiolate complex. The next step involves solvent- metal ion-, pH- and polymer-triggered assembly of the AuNCs, switching on their PL. Compared to the AuNCs, the assembled AuNCs exhibit relatively high QY, long PL lifetime, and blue shift in the PL peak. Nevertheless, up to this stage, there has been a lack of previous studies reporting on the fabrication of the biosensor based on the combination of peptide-induced AIEE of thiolated-protected AuNCs and the use of peptide as a recognition element. In the present study, we introduce four peptide-based sensing platforms through integrating two concepts: (1) peptide triggers the AIEE of glutathione-stabilized gold nanoclusters (GSH-AuNCs) via electrostatic attraction between amino groups of peptide and carboxyl end groups of GSH, and (2) the peptide-AuNC aggregates were disassembled by the complex formation between target analyte and peptide or enzymatic analyte-mediated hydrolysis of peptide substrate. The recognition events of the presented sensors include the complexation of AG73 peptide with heparin, the hydrolysis of arginine- and glycine-rich peptide (RG peptide) by trypsin, the dephosphorylation of phosphopeptide by alkaline phosphatase (ALP), and the binding of cyclic RGD peptides to integrin

receptors. These AIEE-based probes possess high selectivity, comparable sensitivity, remarkable reusability, and great simplicity over the previously reported sensors. Importantly, they were demonstrated to be practically useful for quantitative determination of target analytes in biological fluids and selective imaging of cancer cells.

Keywords: Thiolate-Protected Auncs, Peptide

POSTER SESSIONS

Id-091

Multilayer Hybrid Composites Based on Clay-Paa-Lignin for Biomedical Applications: Synthesis, Characterization and Hemocompatibility

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Abstract: Lignin is a degradation-resist biopolymer, with relatively low hydrophilicity, which can be obtained from different sources, in addition, lignin is considered a raw material of high medical interest, also for its environmental- and skin-friendly nature.[1] Recently, biocompatibility of several lignin-base compounds with carbohydrates, poly(3-hydroxybutyrate), chitin among others have been published suggesting that is a promissory material for functional applications.[2] In particular, we are interested in the development of hemo-compatible surface from different chemical strategies. Here, the building of multilayer hybrid composites based on clay-PAA-lignin is shown. For this, bentonite surfaces were chemically modified with trichlorovinylsilane in order to produce the superficial activation of the clay. Subsequently, poly(acrylic acid), PAA, chains were inserted on the superficially-active clay by free radical reactions, in order to generate surface carboxylic acid groups. On the other hand, lignin was obtained from sugarcane bagasse using the basic delignification method and incorporated into the polymer matrix by urethanization with 4,4´-methylene-bis-(phenyl isocyanate). By this method, lignin coating on inorganic particles were obtained using urethanes links. Different clay-lignin ratios were evaluated. Finally, the material obtained was characterized by elemental analysis, ultraviolet-visible spectroscopy, thermal analysis, infrared spectroscopy and scanning electron microscopy. In addition, absorption water capacity, cationic exchange capacity and antibacterial and hemocompatibility properties were studied depending on the pH and ionic strength. In addition, protein absorption capacity was evaluated. It is concluded that through the proposed methodology it is possible synthesize multilayer hybrid systems based on lignin. These systems shown an adequate hemocompatibility and protein adsorption capacity depending on pH.

Keywords: Poly(Acrylic Acid), Antibacterial, Hemolisys, Bentonite

Financial Support: Mindtech s.a.s. and Universidad del Valle

References

[1]. MP Vinardell, M Mitjans. Int J Mol Sci. 2017:18(6):1219

[2]. P Morganti, S Danti, MB Coltelli. Res Clin Dermatol. 2018;1(1):5-11

POSTER SESSIONS

Id-107

Nanoformulation of Peppermint to Increase Acaricide Activity

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Abstract: Essential oils are being used as an alternative to synthetic pesticides due to pest repellent features combined with a low impact on environment. However, the period of time in which they are active is limited. Nanoformulation could be used to improve the essential oil efficiency as a putative pesticide. In this work, we have test different conditions to achieve chitosan nanocapsules loaded with peppermint (*Mentha piperita*) essential oil. The encapsulation of the essential oil in chitosan nanoparticles was carried out using chitosan with low molecular weight (Mw 50,000–190,000 Da, viscosity 20–300 cP, 1%wt) that was dissolved in an acetic acid solution (1%v/v) under magnetic stirring. Polysorbate was added as an emulsifier for essential oil in chitosan solution and allowed to stir to obtain a homogeneous solution. Then, peppermint essential oil was dropped into chitosan/tween 80 solution. The sodium tripolyphosphate solution was separately prepared and, afterwards, slowly added into oil-loaded chitosan/tween 80 solution. The cloudy solution was allowed to stir to gain a homogeneous solution. To investigate the effect of pH of oil loaded chitosan nanoparticles, two nanoparticle solutions with the same compositions were prepared and their pH was adjusted at 3.5 and 5.5 by adding HCl/or NaOH solutions. The encapsulation efficiency and the particle shapes and sizes of chitosan/TPP loaded with the essential oil were investigated as a function of the pH of chitosan solution. The acaricide activity of the produced oil-loaded chitosan/TPP nanoparticles prepared at various pHs was also studied. The encapsulation efficiency was in both cases over 90% and the loaded nanoparticles at pH 3.5 have spherical shape whereas at pH 5.5 shapes were irregular. Average diameters varied between 200 and 500 nm depending on the pH used in the synthesis. Results also indicate that peppermint acaricidal activity increased due to the nanoformulation.

Keywords: Nanocapsules, Acaricide, Peppermint

POSTER SESSIONS

Id-110

Biological activity of phlorotannins from arctic brown algae fucus vesiculosus

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Abstract: Arctic brown algae fucus vesiculosus is a unique raw material for the production of a number of substances with a wide range of consumer properties. One of the most significant groups of compounds that determine the pharmacological significance of brown algae are polyphenols, namely the phloroglucin polymers - phlorotannins. However, the relationship between the molecular weight and the antioxidant activity (AOA) of the phlorotannins of brown algae is still poorly understood. So, the purpose of this work is identification the relationship of AOA with the polymolecular properties of phlorotannins of arctic brown algae fucus vesiculosus, as well as to evaluate the effectiveness of the using of phlorotannins as biologically active substances.The polyphenol fraction was isolated according to a scheme developed by the authors: the algae were degreased with chloroform, extracted with water to extract the complex of hydrophilic substances, the extract was desalted with ion exchangers, polysaccharides and mannitol were precipitated, and then the polyphenol complex was extracted with a mixture of ethyl acetate and butanol from the purified aqueous extract. To reveal the interrelationship of antioxidant activity from the molecular weight of phlorotannins, the polyphenol complex was divided into fractions using column chromatography on a Sephadex LH-20 sorbent with a system of 21 eluent compositions of ethanol-water and ethanol-acetone.The highest antioxidant activity, comparable to the activity of ascorbic acid, is manifested for polyphenol fractions characterized by molecular weights in the range of 8-18 kDa. A further increase in the average molecular weight leads to a decrease in the antioxidant activity of the samples, which is likely due to mutual screening and a decrease in the availability of active sites. During the mass spectrometric analysis, a number of polyphenolic compounds were detected in the mass range from trimers to octamers. It has been established that the most active fractions are enriched in polyphenols with six to eight units of phloroglucin.Biological activity was evaluated for the obtained fractions of polyphenols. The fractions with the highest antioxidant activity show the greatest bacteriostatic effect for 50-85% of bacterial cultures, moreover, this activity is higher for gram-positive bacteria than for gram-negative bacteria. It was established that the fungistatic effect for the studied samples is less significant and reaches a maximum of 35%. It was also found that the polyphenol fractions do not inhibit the phagocytic activity of neutrophilic granulocytes in human blood, and, therefore, do not possess immunosuppressive properties.As a result of the research, the most biologically active fraction of polyphenols of arctic brown algae was revealed. The established high

antioxidant, bacteriostatic and phagocytic activity of polyphenol fractions shows the significance of these compounds as biologically active substances.

Keywords: Arctic Region, Brown Algae, Fucus Vesiculosus, Polyphenols, Phlorotannins, Molecular Weight, Antioxidant Activity, Biological Activity

POSTER SESSIONS

Id-124

Bacterial Exopolisaccarides as Scaffolds of Nanomaterials

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Abstract: The possibility of synthesizing hybrid materials by using microorganisms is nowadays a field that is attracting attention. We present in this work the use of exopolysaccharides (EPS) produced by two bacteria as a scaffold to incorporate gold nanoparticles. Both materials have special interest due to the possibility of modulate its properties: Because gold nanoparticles (AuNPs) have many unique optical, chemical, electrical, and catalytic properties, they have been investigated for biological and chemical sensing applications [1]. AuNPs absorb light at its surface plasmon resonance (SPR). The SPR wavelength of these nanoparticles can be tuned from the visible to the near infrared (NIR) region by changing the size, shape, aggregation and chemical environment. Actually, this allows the development of AuNPs with the desired properties for biological and medical applications. Bacterial EPS have been used in research and industry (i.e. food industry), because of its biocompatibility and no toxicity: On one hand, we use *Lactobacillus fermentum*, a GRAS probiotic bacterium (Generally Recognized as Safe), for synthesize two different polymers: dextran and levan [2]. These EPS function as platforms for chemically synthesized AuNPs, or as reductants for its synthesis from Au(III). On the other hand, *Acetobacter xylinum*, is a bacteria known for its ability to produce cellulose. This EPS presents attractive properties such as high degree of crystallinity, chemical purity, and easy obtention and purification [3]. Both exopolysaccharides are able to incorporate gold nanoparticles with different shapes. Moreover, the combination of both materials permits the generation of a new hybrid material that improves AuNPs stability and solubility, and tune the aggregation of the NPs changing the SPR wavelength to the NIR region. This fact is really interesting because NIR wavelength is able to penetrate across the skin, so it is possible to develop, for example, a colon cancer treatment based on hyperthermia by irradiating gold nanoparticles.

Keywords: Bacterial Exopolysaccharides, Celullose, Gold Nanoparticles

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References

[1]. H. Jans, & Q. Huo. *Chem Soc Rev*, **2012**, 41, 2849-2866.

[2]. González, A. (**2018**). *Materiales bioinspirados basados en bacterias. Aplicaciones biomédicas* (Doctoral dissertation, Universidad de Granada).

[3]. D. Klemm, B. Heublein, H.P. Fink & A. Bohn. *Angewandte Chemie International Edition*, **2005**, 44(22), 3358-3393.

POSTER SESSIONS

Id-129

Polymeric Materials with Hydrolytic Activity

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Abstract: Hydrolytic enzymes are the most used enzymes in catalysis and medicine. Nevertheless, the limitations of hydrolases usage are the high cost of highly purified enzymes and their single usage and absence of prolonged action. Polymeric materials, based on polyvinyl alcohol (PVA) and its compositions are the promising matrices for entrapment of hydrolytic enzymes because of their economy, nontoxicity, biodegradability and high capacity. In this study we have investigated the entrapment of pig liver microsomal fraction (esterase activity –17.25 U/mg protein) in PVA (M.м. 120 000) cryogel. As a result, a water-insoluble biocatalyst with 65 % preservation of the initial esterase activity was obtained. There were no significant differences in pH- and thermoprofiles of free and entrapped microsomes. But it was shown a 2-fold improvement of thermal stability of the entrapped microsomes. Such enhancement of thermal stability seems to reflect stabilization of microsomes by the carrier, which prevents the membrane-bound proteins denaturation, and as a consequence, disaggregation of the vesicles. Enantioselective hydrolysis of (R,S)-3-hydroxy-7-bromo-5-phenyl-1,2-dihydro-3*H*-1,4-benzodiazepin-2-one esters, prospective hypnotic and anxiolytic drugs, was conducted using entrapped microsomal fraction in a batch process. The absolute configurations of the substrate enantiomers were determined by single crystal X-ray diffraction analysis as (S)-forms (ee_s > 97 %). Thus, the pig liver microsomal carboxylesterase reveals higher specificity to R-enantiomers of studied esters. The maximum conversion of esters was found after 5 cycles of biocatalyst usage. Biologically active polymeric material with entrapped *Bacillus thuringiensis* var. israelensis IMV B-7465 protease with caseinolytic, collagenase and elastase activities based on PVA and chitosan (10/1, w/w) was developed and characterized. Chitosan and its compositions are biodegradable polymers with unique biological activity, antimicrobial, hemostatic action, which allows to significantly shorten the treatment time and determine the prospects of its application in reparative medicine. The coating obtained is a promising product for medical use as a wound-dressing agent. Results of SEM showed that the surface of preparations was relatively smooth, without any cracks, with fairly good structural integrity. Polymeric system contains enzyme agglomerates (of various sizes but not greater than 5 microns in diameter). The enzyme is found both on the surface and in the polymer layer. Studying of physico-chemical properties of the coating has shown that the pH-optimums of the free and entrapped enzyme have the close values (6.5-7.0 units). However, the entrapped one was characterized by increased proteolytic activity in the acidic (14-35 %) and alkaline (7-32 %) regions (pH 3-6 and 8-9, respectively). Protease in polyvinyl alcohol/chitosan coating retains more than 95 % of its initial proteolytic activity after nine

months of storage.

Keywords: Polymeric Materials, Microsomal Fraction, Protease, Polyvinyl Alcohol

POSTER SESSIONS

Id-137

Preparation of Biocompatible Graphene Oxide Coatings on Metallic Substrates

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Abstract: Metals play a significant role as implantable biomaterials: they are used for fabricating stents and parts of artificial heart prostheses (steel 316L), orthopedic implants (titanium alloys), for dentistry and cardiovascular implants with improved flexibility and radiopacity (gold). However, metals used in construction of implantable medical devices are a cause of inflammatory reactions and degrade after a long-term implantation. Therefore, novel methods of metal surface improvement are needed. One of the solutions to this problem may be a bio-passive coating made of graphene oxide as it can possible provide uniform, thin and tight layer preventing both ion release from the metallic materials and adhesion of components of tissues and body fluids.In the presented work we proposed preparation of graphene oxide (GO) through two methods: graphite oxidation (top-down) and organic acid pyrolysis (bottom-up) and then using both types of GO in the processes of chemical and electrochemical coating. Electrochemical method of coating has been performed on steel 316L. Gold has been coated chemically in a two-step process including formation of amine-thiol monolayer on gold and chemical bonding of GO through amine coupling technique. GO flakes prepared with both methods of synthesis were characterized with the use of SEM and TEM microscopy. The obtained coatings were characterized using SEM microscopy, FTIR spectroscopy and contact angle measurements. Biocompatibility of coatings was measured with the use of XTT method. Both proposed GO preparation methods resulted in obtaining GO flakes of differing but highly repeatable properties and were possible to be used as coating materials. Both proposed coating methods resulted in obtaining stable GO layers on metals that adhere well to the surface. Obtained final coated materials presented low cytotoxicity against mammalian cells.

Keywords: Biomaterials, Biocompatibility, Graphene Oxide

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POSTER SESSIONS

Id-139

Surface Plasmon Resonance System for Fast Diagnostics of Tuberculosis

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Abstract: Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* bacteria (MTB). It killed millions of people in the past centuries and is still among the leading causes of infectious morbidity. TB is considered one of the most important diseases to which prevention, treatment and global research is insufficient. This is also a result of increasing number of TB cases caused by multidrug resistant MTB strains, which are difficult to treat even in the developed countries. One of the bases of TB treatment is fast detection. In the recent years new methods of TB detection have been developed, which base on molecular detection of DNA, proteins and peptides of MTB bacteria. In the presented work we attempted to design a new method of TB diagnostics that was based on surface plasmon resonance (SPR) phenomenon. We designed a detection system which was meant to rapidly detect whole MTB bacteria cells in human sputum. The system consisted of microfluidic chip housing Spreeta2000 - miniature SPR chip, which was modified with antibodies specific against MTB. The other components such as micropump, valve, sample containers etc. were all designed to fit in a hand-held case. The point of the design was to provide a fast, easy to use, portable device that could serve its purpose of a point of care system. The device was tested on both MTB membrane protein and living MTB bacteria. Tests on real TB positive patients' samples have been performed as well. The specificity of the detection was checked by tests on different bacteria species. The resulting device exhibited good limit of detection of 10^4 cfu/ml. The specificity of detection was also confirmed. Samples from two TB patients have been correctly diagnosed. The time of whole detection procedure was approximately 15 minutes which is currently the fastest obtained TB detection time. The system is further planned to be developed by improvement of the microfluidic chip and addition of automatic detection feature and can be a promising solution to the need of new, fast and reliable TB diagnostic methods.

Keywords: Surface Plasmon Resonance, Point-Of-Care Detection, Tuberculosis

Acknowledgement: This work has been supported by the National Science Centre, Poland, project registration number: 2017/25/N/ST8/01027.

POSTER SESSIONS

Id-145

Free-Volume Characteristics of Polymers with Different Crosslink Density Used for Construction of Laccase-Based Amperometric Biosensors

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Abstract: Recently, the integration of micro- and nanotechnologies in the development of high sensitive biosensors has been proved on the example of a constructed innovative amperometric biosensor on the surface of the gold planar electrode by using an ureasil/As_2S_3 composite as a host polymer matrix and immobilized commercial laccase [1]. It has been found that the biosensor based on the ureasil/As_2S_3 composite was characterized by very high sensitivity to be 38.3 times higher in compare with pure ureasil matrix; while the ureasil/As_2S_3 composite with incorporated ion-synthesized silver nanoparticles results in decreasing the biosensor sensitivity up to 2390 times. Therefore, knowledge of the properties of the microstructure of such materials is important in terms of optimizing the regulated properties of the amperometric biosensors. A swelling test provides information about a crosslink density and flexibility of polymer network and is commonly used to characterize the structure of a cross-linked polymer. At the same time, positron annihilation lifetime spectroscopy (PALS) is known as a progressive method for microstructural analysis of macromolecular structures [2,3]. Combination of these both methods allows to get information about network properties of the polymer matrixes and the results obtained should be further compared with sensitivity of bioelectrodes constructed using the polymer matrixes [4]. In the present work, the pure ureasil, ureasil/As_2S_3 composites of different history (fresh, heated, aged during one year and aged more than five years samples), and photocross-linked polymers based on the epoxidized linseed oil (ELO) were selected for research by means of swelling and PALS measurements. It is found that the relationship between the crosslink density as revealed by swelling and the free-volume thermal expansion characteristics such as coefficients for the thermal expansion of free-volume holes α_{F1} and α_{F2} in the regions below and above T_g and their difference ($\alpha_{F2} - \alpha_{F1}$) as revealed by PALS is not the same for the ureasil-based and photocross-linked polymers studied. The role of weak physical

bonds that can reduce the network flexibility and increase T_g, although the system may have a low crosslink density, is considered.

Keywords: Organic-Inorganic Ureasil Polymer; Photocross-Linked Polymer; Swelling; Cross-Linking; Positron Annihilation; Free Volume

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References

[1]. T. Kavetskyy et al., J. Appl. Polym. Sci., 134, 45278(1-7) (2017).

[2]. Y.C. Jean et al., Macromolecules 46, 7133-7145 (2013).

[3]. H. Švajdlenková et al., Macromol. Chem. Phys., 1800119 (2018).

[4]. T. Kavetskyy et al., Acta Phys. Pol., A, 132, 1515-1518 (2017).

POSTER SESSIONS

Id-151

Comparison of Pullulan Production Performances of Different *Aureobasidium Pullulans* Brazilian Isolates Using a Low-Cost Feedstock

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Abstract: Most of the polymers widely used, including those applied as coating for food packaging, are “chemically synthetized from petroleum” (or “derived from crude oil”) that “poses” (or “creates”) a serious environmental problem facing the daily discharges of large amounts of these nondegradable pollutants. Thereby, the use of natural polymers, especially those produced by microorganisms, as surrogate to the petroleum-based ones, is of great interest as they are biodegradable and atoxic. In addition, microorganisms are metabolically versatile and, therefore, capable of assimilating different feedstocks or even industrial wastes. Pullulan gum is an exopolysaccharide aerobically produced by yeast-like fungus *Aureobasidium pullulans* strains that besides its importance for film coating preparations, with oxygen-barrier property, has many advantages, e.g., texturizer for ham, tofu and sausage; potentiating agent or additives to food colorant, maintain flavor and aroma by microencapsulation, in prebiotic, by promoting the selective growth of *Bifidobacterium* spp. in the human intestine, inactivation of plaque-producing microorganisms, gingivitis and bad breath, among others. In the present study, six *A. pullulans* strains of brazilian isolates were tested for pullulan production by using cane sugar (30 g/L) and brewery yeast waste (2 g/L), as the main carbon and nitrogen sources respectively, to implement the cost reduction of process. Experiments were carried out in 500-mL Erlenmeyer flasks each containing 150 mL medium, pH 6, at 28ºC and 150 rpm for 96 h. All strains were able to produce pullulan, varying from 2 to 11 g/L, and yield in the range 0.1 and 0.5 g/g. Notwithstanding Y-2092 strain, isolated from Ipanema beach, was the best pullulan producer. The maximum production of pullulan was achieved in fermented broth with pH control, while without adjusting pH, the production was 75% lower; in this condition, pH dropped to 3, favoring filamentous growth of yeast-like inocula, which is a hindrance for pullulan biosynthesis. The FTIR analysis of produced biopolymers revealed chemical structure similar to each other and with a commercial sample (Sigma-Aldrich). Also, there was a decrease of viscosity of obtained pullulans with increasing shear rate between 0.1 s^{-1} and 500 s^{-1}, suggesting that them all exhibit pseudoplastic behavior; although the order of magnitude was less than 1 order of magnitude, which represents a weak behavior. This performance makes employment of biopolymer possible for the coverage of post-harvested vegetables and fruits, and in obtaining packaging for the food industry. Finally, the results suggest the pullulan production may be cost-effective based on low-cost and renewable feedstocks, in particular by using a brewery waste, supporting a sustainable development.

Keywords: Chemically synthetized from petroleum, derived from crude oil, *Aureobasidium pullulans,* FTIR

POSTER SESSIONS

Id-188

Green Synthesis and Characterization of Cu Nanoparticles for Functional Coatings with Antibacterial Properties

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Abstract: Metallic and metal oxide nanoparticles have been extensively studied, due to their antimicrobial potential, as a possible alternative to conventional antibiotics agents in various applications.

In the present work the synthesis of Cu nanoparticles using a simple, cost effective and eco-friendly method is reported. Plant extract from Thymus vulgaris and Mentha piperita were used as mild, non-toxic reducing agents. The stabilization of the obtained nanoparticles is achieved through fitocomponents from the plant extract, without using any surfactant. The formation of the nanoparticles in various conditions (reagent concentration, type of the extract) was monitored by absorption spectroscopy. The size and morphology of the prepared nanoparticles were characterized using dynamic light scattering (DLS), transmission electron microscopy (TEM) and X-ray diffraction (XRD). The cristallinity, size and polydispersity of samples depend on the concentration and type of the plant extract. The stabilization of the nanoparticles and surface functionalization with fitocompounds were investigated using FT-IR and Raman spectroscopy. The biological activity of the metallic nanoparticles was evaluated against common bacterial and fungal strains (E. coli, P. aureus and C. albicans). The Cu nanoparticles prepared in both plant extracts exhibit superior antibacterial activity compared to the reference Cu nanoparticles (obtained from reduction with standard chemical reagents).

Keywords: Cu nanoparticles, antimicrobial, environmentally friendly synthesis, plant extract

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POSTER SESSIONS

Id-204

Enhancement of Ultrasonic Cavitation and Heat Release in Aqueous Suspensions of Mesoporous Silicon Nanoparticles

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Abstract: Nanoparticles based on porous silicon attract a lot of interest because of the outstanding properties of biocompatibility and biodegradability in the living environment. Wide opportunities of the surface modification, as well as efficient photoluminescence in the visible and infrared range, make them perfect agents for various applications, including targeted delivery of chemotherapeutic drugs. The current study is devoted to both theoretical and experimental investigation of sonoactivation of drug-loaded mesoporous silicon nanoparticles coated by biopolymers with the MHz-range ultrasound of moderate intensity. The role of two fundamental effects – acoustic cavitation and ultrasound-induced heat release – is taken into account. The presence of solid porous nanoparticles lowers the cavitation threshold in aqueous media due to the growth of air bubbles from the nuclei located inside numerous pores on the NP surface. We prepared porous silicon nanoparticles (PSiNPs) with amphiphilic properties, i.e. outer surface of PSiNPs was hydrophilic in order to provide good biocompatibility of the particles, while inner surface was hydrophobic. Initial mesoporous silicon layers were coated by hydrophobic octadecylsilane (ODS), then they were fractured to 200-nm PSiNPs in a mixture of ethanol and water in a planetary ball mill. This procedure also created a hydrophilic surface. The experimental setup to simultaneously measure the heating of the nanoparticle suspensions and monitor the cavitation intensity by measuring the subharmonic magnitude was developed. Hydrophobic surface inside PSiNPs enhances cavitation effect under ultrasonic activation, which resulted in a twofold decrease of cavitation threshold at frequency of 2.08 MHz. We evaluated two main mechanisms leading to the heating effect in nanoparticle suspensions. The first mechanism was associated with the enhanced scattering and viscous dissipation of the ultrasound energy in the aqueous medium filled with solid nanoparticles. This mechanism dominated at low intensities. The measured temperature evolution in suspension was in agreement with data obtained from the numerical calculations of heat transfer equation with specified boundary conditions. The second mechanism was used to explain the discrepancies between the experimental and theoretical results at higher ultrasound intensities, as well as the differences between the suspensions of the oxidized Si nanoparticles and PSiNPs with hydrophobic pores. These discrepancies were because of the acoustic cavitation, which led to the high-energy bubble collapse. This contribution was observed by an apparent excess of the experimental heating curves over the simulated ones as well as strong temperature fluctuations at US pressure amplitudes exceeded the cavitation threshold. The heating dynamics correlated well with the increase of measured subharmonic

magnitude in the spectrum of the acoustic signal transmitted through the cuvette. The highest values of heating were obtained for the suspension of PSiNPs which inner pore walls were hydrophobic while the external surfaces were hydrophilic. The results of the present study obtained for the biocompatible and biodegradable porous silicon nanoparticles shed light on their behavior under US radiation boosting comprehensively the development of inorganic nanoparticles for theranostic applications.

Keywords: Drug Delivery, Silicon Nanoparticles, Ultrasound, Cavitation

POSTER SESSIONS

Id-210

Microstructure and Mechanical Properties of Co-Cr Removable Partial Denture Fabricated Using Selective Laser Melting

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Abstract: The objective of the present study was to investigate the microstructures and mechanical properties of Co-Cr alloys using selective laser melting (SLM) and heat treatment to assess their potential use in removal partial denture (RPD) frameworks.

Three groups of dumbbell and framework specimens made of Co-Cr alloys were prepared using casting (CArST), selective laser melting (SLM) and SLM followed by the heat treatment (SLM+H). The microstructures of the specimens were evaluated using optical microscopy (OM), scanning electron microscope (SEM), and X-ray diffractometer (XRD). The mechanical properties were evaluated using a tensile test according to ISO 22674. The retentive force and fatigue resistance were analyzed using the insertion/removal test. Data were statistically analyzed using one-way ANOVA and Tukey's multiple comparison test. The results from OM and SEM showed that the microstructural was strongly influenced by different fabricated procedures. The typical dendritic grains predominated in the CAST group. The SLM and SLM+H groups exhibited clearly laser scan traces and revealed the presence of fine grains. The mechanical properties of all groups satisfied the type 5 criteria in ISO 22674 (0.2% yield strength (YS): >500 MPa). The SLM group showed the highest ultimate tensile strength (UTS) and 0.2 % YS followed by the SLM+H and CAST groups. The percent elongation value was higher in the SLM+H and SLM groups than the CAST group. It was suggested that a proper heat treatment was an efficient strategy for improving the mechanical properties of SLM Co-Cr alloys that showed acceptable tensile ductility.

Keywords: Co-Cr alloy; SLM; selective laser melting; removable partial denture; framework

POSTER SESSIONS

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Advances in Development of Biosensing Electrochemical Platforms for Mycotoxins Detection

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Abstract: Mycotoxins are relatively small molecules with total molecular weights less than 500 Da, which occur as secondary product of the development of parasitic fungi, such as *Aspergillus, Fusarium, Penicillium, Claviceps and Alternania* genus in plants and products stored, inducing adverse health effects (carcinogenic, teratogenic, mutagenic, nephrotoxicity, hepatotoxicity and immunotoxicity) over the humans and animals [1]. These compounds act by inhibition of protein synthesis at the ribosomes in cell, therefore cell division being inhibited too. Contamination with these toxicants is considered to be unavoidable and unpredictable, due to their high stability against heating, physical and chemical treatments, being resistant to the industrial food processing [2]. Therefore, in the last period, there have been an increasing need and request for development of fast, portable and cheap analytical methods for mycotoxins detection. Different analytical techniques, such as chromatography, UV-absorption, spectrometry, fluorescence and immunochemical assays have been reported in literature for detection and quantification of mycotoxins [3], but since classical methods usually allows a specifically identification of a wide spectrum of toxins, the biosensors allow the detection of one class of compounds having a common biological target. Among biosensors, immunosensors represent a suitable alternative that has grown in the last decades in development of sensitive, selective, simple and reliable systems for mycotoxins detection. The use of specific monoclonal antibodies or aptamers as bioreceptors coupled with a physical transducer such as gold, carbon or graphite, leads to miniaturization of the systems and to an improvement of the sensitivity, speed and low cost of analysis [4]. Different materials may be used for the bioreceptor immobilization; our work being focused on electropolymerised ones. An oriented immobilization of bioreceptors can be achieved due to the simplicity and easy functionality of the electropolymerised films, allowing in this way an increase of the binding efficiency and minimizing non-specific adsorptions on the biosensor surface. Electrochemical immunosensors for mycotoxin detection, especially for aflatoxin B1 and its metabolite aflatoxin M1, will be presented.

Keywords: Immunosensors; Electropolymerisation; Electrochemical; Mycotoxin Detection

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References

[1]. S. Marin, A.J. Ramos, G. Cano-Sancho, V. Sanchis, *Food and Chemical Toxicology* 2013, 60,218-237.

[2]. J.W. Bennett, M. Klich, *Clin.Microbiol. Rev.*2003, 16, 497-516.

[3]. D.R. Milicevic, M. Skrinjar, T. Baltic, *Toxins* 2010, 2, 572-592

[4]. K. Y. Goud, A. Sharma, A. Hayat, G. Catanante, K. V. Gobi, A.-M. Gurban, J.-L. Marty, Analytical Biochemistry 2016, 508, 19-24.

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Transplantation Effects of Fibroblast and Biodegradable Polylactide Film Association on the Morphology of Regenerating Ischemic Cutaneous Wounds

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Abstract. Despite the better understanding of the morphological picture of cutaneous wound healing in blood flow disturbances, persistent non-healing defects remain a serious public health problem. The study was performed on 14 mice of the C57/B1 line aged between 5 and 7 months. The animals were divided into the control and the experimental group with 7 mice in each one. A model ischemic wound on the skin of experimental animals was covered with a poly (L-lactide) film with attached xenogenic fibroblasts and then with an aseptic VoscoPran dressings with levomekol. On day 12, a scar was intraoperatively excised, embedded in paraffin and stained with H&E by the Weigert-Van Gieson method. A degradable polylactide film with xenogenic fibroblasts cultured on it accelerates the wound healing process by 31.41%, taking into account the time of epithelialization of the wound, eruption of the ring-retaining seams, and the falling off of the ring itself (on day 8.5±0.1 days versus on day 12.4 ± 0.10 in the controls). At that, the thickness of the epidermis against the background of wound closure with a polylactide film with xenofibroblasts was on average less by 2.63% than in the control group but it was more differentiated and gave rise to skin derivatives, hair. The granulation tissue of the regenerating cutaneous wound in the experimental group showed the initial signs of fibrosis without inflammatory cell infiltration. Collagen fibers acquired an ordered arrangement, their area increased by 16.2%, and vascularization decreased considerably (by 30.43%). On day 12 of wound healing, the thinned remains of the film could be found only in the center of the wound above the formed epidermis and the scab was completely absent. Thus, the biodegradable polylactide film with xenogenic fibroblasts cultured on it improves significantly the microscopic parameters of the wound healing process and the macroscopic signs of healing of an ischemic cutaneous wound.

Keywords: cutaneous wound, polylactide film, fibroblast, regeneration, angiogenesis.

POSTER SESSIONS

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New Hybrid Biomaterials Based on Natural Polymers and Silver Nanoparticles for Wound Healing

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Abstract: Skin is the largest and most complex organ of the human body and wounds from physical and chemical trauma can significantly compromise the skin's barrier and affect its physiological functions. Nowadays, different types of biomaterials based on natural or synthetic polymers are continuously developed for the treatment of various chronic wounds. The aim of this study was to obtain and characterize natural biomaterials, similar to the skin extracellular matrix, based on collagen (COL), glycosaminoglycans (GAG) and soluble elastin (EL) for biomedical applications.COL type I was obtained from bovine tendon, bovine tracheal cartilage was the source for GAG, whereas EL peptides were prepared from insoluble elastin from bovine ligamentum nuchae using an alkaline process. The polymers were mixed in two different ratios, COL: GAG:EL 10:1:0.5 and 10:1:1,and dried at 30°C to obtain thin, elastic sheets of composite biomaterial or incubated at pH 7, 37 °C to form hydrogels. The physico-chemical characterization of the biomaterials consisted in determination of the swelling degree and *in vitro* biodegradability in the presence of collagenase. Ultrastructural observations of the biomaterial surface were performed by SEM and *in vitro* biocompatibility tests were conducted on NCTC clone L929 cell line using the MTT assay. Cell adhesion was analyzed by phalloidin/DAPI and Live/Dead assays, whereas the wound healing capacity was evaluated by cell migration in a scratch model *in vitro*. The selected variant was improved by addition of silver nanoparticles prepared from $AgNO_3$ using collagen as reducing and stabilizing agent. Their antimicrobial activity was tested on relevant strains in order to establish the optimal concentration. Turbidity values registered during the reaction between polymeric components sharply decreased for the variant COL:GAG:EL 10:1:0.5, which is similar to that in skin extracellular matrix and indicated the preparation of a stable matrix. The swelling and biodegradability degree of composite sheets varied proportional to the period of UV exposure. Composite variants showed a fibrillated, dense and microporous ultrastructure with pore sizes varying between 0.5-10 µm. *In vitro* cytotoxicity tests exhibited cell viability values higher than 80% after 48h of cultivation with each polymer and their mixtures, indicating a good biocompatibility of the tested biomaterials. Fluorescence microscopy observations confirmed good adhesion of cells, while stimulation of cell migration took place in the wound healing model *in vitro* in the presence of polymeric mixtures. TEM and SEM revealed formation of silver nanoparticles and their distribution within the variant COL:GAG:EL 10:1:0.5. Their antimicrobial activity was maintained after embedding in the composite

materials. All structural and biocompatibility attributes recommend these hybrid biomaterials for further testing in wound healing models *in vivo*.

Keywords: collagen, elastin, silver nanoparticles, cell culture, biocompatibility, wound healing

POSTER SESSIONS

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New Composite Materials as Potential Dressings in Wound Care Treatment

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Abstract: Recent advances in skin wound healing involve the use of natural polymers in combination with plant-derived bioactive molecules. These smart wound dressings enhanced the healing process by providing a template for the regeneration of the damaged tissue, releasing simultaneously the plant-derived molecules with antioxidant, antimicrobial and anti-inflammatory properties. This study aimed to develop novel wound dressings containing natural polymers, such as collagen and agarose, mixed with polyphenol-rich extract of *Artemisia absinthium* (wormwood). Collagen type I solution was obtained from bovine tendon by enzymatic method with 0.5 mg/mL pepsin in 0.5M acetic acid, followed by precipitation with 2.4 M NaCl and dialysis against distilled water. Agarose, the natural polysaccharide derived from the red algae was commercially supplied. The polyphenolic extract was prepared from aerial parts of wormwood using 70% (v/v) ethanol as extraction solvent. The resulting supernatant was evaporated and lyophilized. Mixtures of collagen-agarose and collagen-wormwood polyphenolic extract were prepared in a ratio of 1:0.5 and 1:0.1, respectively and conditioned as 3D porous materials by freeze drying technique. Multicomponent material was prepared by blending all three components (collagen, agarose and wormwood extract) in a ratio of 1:0.5:0.1 and lyophilized. Their physicochemical properties, such as porosity, swelling degree and biodegradability were further investigated. A sample consisting of freeze-dried collagen type I solution was used as control. Biological tests were performed *in vitro* in a model of 3D porous composite materials injected with human dermal fibroblasts and human HaCaT keratinocytes, respectively. Cell proliferation was assessed by MTS test after 2 and 5 days of cell constructs incubation, while cell adhesion and viability were observed by fluorescence microscopy using Live/Dead kit. Composite materials capacity to scavenge ROS was evaluated *in vitro* on skin cells using TBHP as oxidative agent. DCDHF-DA assay was used for measuring the level of intracellular ROS production by flow-cytometry and catalase activity and the total glutathione level were determined by spectrophotometric methods. The composite materials exhibited a slight decrease of porosity (80.08-85.33%), compared to collagen sample (97.06%), but higher swelling ability (over 2185%) and good *in vitro* stability in collagenase solution. Cell culture studies showed stimulation of cell proliferation for keratinocytes cultivated within composite materials and in a lower degree for dermal fibroblasts. Higher cell proliferation was observed in the composite material containing collagen and polyphenol-rich wormwood extract (1:0.1). Fluorescence staining of cells injected in composite materials showed that they maintained their normal specific morphology. In addition, cells were viable and adhered well to the porous structure of composites, compared to collagen sample. The composites materials containing

wormwood extract exhibited *in vitro* antioxidant activity by stimulating the endogenous antioxidants and protecting thus the cells against the oxidative stress. All these results demonstrated that composite materials based on collagen-agarose-polyphenols mixtures can be useful as potential wound dressings and in skin tissue engineering.

Keywords: Wound Dressing, Collagen, Agarose, Polyphenol-Rich Extract, Biocompatibility

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Biopolymer Production by a Brazilian Aureobasidium Pullulans Strain Using Agroindustrial Feedstocks

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Abstract: The use of microbial polymers in various day-to-day utilities has become increasingly common due to their advantages over the synthetic ones, mainly because biodegradability, rheological properties, production independence of area and climatic conditions, low quality variation, and possibility to use renewable energy sources, including regional biomass. Besides, there are various potentially biopolymer-producing microorganisms, with a wide metabolic versatility. Among biopolymers, pullulan stands out as unique for food, pharmaceutical and medical applications. The aim of this study was to evaluate the production of pullulan by *Aureobasidium pullulans* UFMG Y1215, isolated from Ipanema beach, Rio de Janeiro, using two crop-based feedstocks – raw sugar (VHP, very high polarized sugar) and corn steep – of current use in bioprocesses as primary carbon and nitrogen sources, respectively, to reduce production cost. Batch process experiments were carried out in 500 mL Erlenmeyer flask with 100 mL of medium and a 2L bioreactor with 1.5 L of medium, pH 5.5, at 28°C, using a 2^2 factorial design with three central points, and the variables were: VHP (10 to 60 g/L) and corn steep (1 to 4 g/L). In shake flasks experiments, at 150 rpm for 48 h, polymer concentration ranged from 1.1 to 5.0 g/L, while sugar consumption varied from 1 to 95%, showing that C and N initial concentrations, as well as C:N ratio greatly influence the fungal metabolism. The maximum value of polymer production and high percent of sugar consumption were achieved using 60 g/L of raw sugar and 4 g/L of corn steep. Nevertheless, experiment performed in the bioreactor system (0.5 vvm and 150 rpm) using the best nutritional concentrations resulted in only 2.7 g/L at 72 h, which corroborates important role of aeration/agitation on fermentation process. The rheological analysis of fermented broths showed a declining viscosity over the shear rate between 0.1 s^{-1} and 500 s^{-1}, suggesting pseudoplastic behavior of all samples. In addition, viscosity measurements of aqueous solution samples (1%, 5% and 10%) of pullulan, previously recovered from cell free fermentation broth of bioreactor using ethanol as precipitating agent, varied between 0.001 and 0.003 Pa.s,, which is represents a weak behavior, although is satisfactory mainly for food and pharmaceutical applications. Finally, it can be stated that pullulan production using low-cost feedstocks is possible, although more related research is needed to achieve cost-effective mass production of pullulan.

Keywords: pullulan; low-cost feedstocks; bioreactor; viscosity.

POSTER SESSIONS

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Cross-Linked Nanocellulose Foams Using Mono- and Disaccharides

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Abstract: Nanocellulose, which is obtained from abundant and renewable sources, showed a significant research interest in the past decade due to its outstanding properties: low density, high strength and flexibility, high water absorption capacity, good bio- and hemocompatibility and the possibility to modify the surface chemistry. Among nanocellulose products, nanocellulose foams showed a growing interest due to the combination of an ultralow density, a tunable porous architecture and mechanical strength. However, cellulose foams present poor mechanical stability in different environments. In order to improve mechanical stability, nanocellulose can be modified by grafting and/or crosslinking using a multitude of crosslinking agents, most of them being either toxic, expensive, or with low crosslinking efficiencies. Therefore, improving the mechanical and thermal properties of nanocellulose foams using eco-friendly approaches is mandatory for a wide range of applications including scaffolds for biomedical field, filters/membranes for water or air filtration, thermal insulation and devices for storage and generation of energy. Mono- and disaccharides were used as non-toxic and eco-friendly crosslinking agents and their effect on the thermal and mechanical properties of nanocellulose foams were thoroughly studied. Improved compression strength and thermal stability were observed after functionalization and crosslinking, given that the hierarchical porous structure of cellulose scaffolds was maintained. Moreover, the surface chemistry of cellulose and the physical, chemical and mechanical properties of the obtained structures were correlated. These new approaches to modify nanocellulose foams using non-toxic crosslinking agents are important for both biomedical and food applications.

Keywords: Nanocellulose Foam Cross-Linking

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References

[1]. Adriana N. Frone, Denis M. Panaitescu, Ioana Chiulan, Cristian A. Nicolae, Angela Casarica, Augusta R. Gabor, Roxana Trusca, Celina M. Damian, Violeta Purcar, Elvira Alexandrescu, Paul O. Stanescu, *Surface Treatment of Bacterial Cellulose in Mild, Eco-Friendly Conditions.* Coatings, 2018. **8**: p. 221.

[2]. Arne Quellmalz, A.M., *Citric Acid Cross-Linked Nanocellulose-Based Paper for Size-Exclusion Nanofiltration.* ACS Biomater. Sci. Eng., 2015. **1**: p. 271-276.

[3]. Kevin J. De France, T.H., Emily D. Cranston, *Review of Hydrogels and Aerogels Containing Nanocellulose.* ACS Chem. Mater., 2017. **29**: p. 4609-4631.

POSTER SESSIONS

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The Fabrication of Carbon Dots by Hydrothermal Reaction for the Detection of GABA

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Abstract: GABA is a significant inhibitory neurotransmitter in the brain and it plays a key role in the psychological disorders such as depression, anxiety, addiction etc. Hence the GABA detection has gained significant importance in the field of neuroscience. The simple eco-friendly carbon dots (CDs) have been synthesized from corn juice (Zea mays) as a natural precursor by using hydrothermal method. These carbon dots are referred as CCDs. CCDs were functionalized by 3-aminophenyl boronic acid and then by NADP+.EDC/Sulfo-NHS coupling reaction was used in the functionalization of CCDs. The as-synthesized CCDs were shown to be 3-5 nm size with high quantum yield (QY) of 11% and have time stability up to 120 days. The fluorescence intensity of the NADP+ functionalized CCDs was quenched due to the electron transfer from CCDs to the NADP+. The stability, sensitivity, and detection strategy of our fluorescence sensing system can be used as an effective probe for detecting the neurotransmitter, GABA using simple, cost-effective, fluorescent carbon dots using GABase enzyme with the limit of detection (LOD) of 0.924 nM. This enzymatic fluorescence sensing system possess potential benefits in the detection of GABA at lower concentrations.

Keywords: GABA, carbon dots, fluorescence, sensing

POSTER SESSIONS

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The Most Important Features of Physiological of Soybean Parameters with Linear Regression on Soybean in Kazakhstan

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Abstract: In 2018 in the field trials of Aktobe agricultural experimental station with using MultispeQ, we provided measurements on 12-soybean variable. Our objective to build linear regression and to select the most important physiological parameters on soybean. We are presenting validation experiments, comparing MultispeQ results with established platforms, and show that it can be usefully deployed in field settings. Using R statistic software, we evaluated measurement on 12 cultivars of soybean. The measurements showed that soybean cultivar factor statistically significant influenced to these plant phenotyping datas: leaf temperature differential, leaf ambient humidity, leaf ambient temperature, leaf angle, fractions of LEF, NPQt, Phi2 и PhiNO and to relative chlorophyll. The cultivar factor did not influence to photosynthetically active radiation measurements. The linear regression was build by R software. As response of linear regression was selected the Leaf Ambient Humidity variable. As the result of linear regression equation in the model were included Leaf Ambient Temperature, Leaf temperature Differential, Photosynthetically active radiation, Chlorophyll (LEF and NPQ) fractions, and relative chlorophyll variables. The analysis showed that these variables can be included into model and were independed from each other.

Keywords: Multispeq, Soybean, Physiological Parameters, Linear Regression, Kazakhstan

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In Vitro Evaluation of the Impact of Powerful Nanosecond Electromagnetic Pulses on Tumor Cells

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Abstract: The aim of this work was to study the effect of powerful electromagnetic pulses (EMP) of nanosecond duration on tumor cells in the *in vitro* system. The study of the EMP effects was performed on mouse Lewis lung carcinoma (LLC) cells obtained from the CLS Bank collection of cell cultures (Germany).For the experiments, cells were seeded into 96-well microplates in 15x10^4 cells / ml amount. The cells were incubated for 20-24 hours under standard conditions and than they were exposed to electromagnetic field with the selected parameters.Evaluation of the cell survival was carried out both visually, assessing the morphological changes of the cells using light microscopy, and by the colorimetric method using the MTT test.The following parameters of the electromagnetic field were used in the experiments: electric field intensity - 40 kV / cm; pulse repetition rate - 1, 5, 10, 25, 50, 100, and 200 Hz; the total number of pulses - 100, 500, 10 000, 25 000 and 50 000.The EMP cytotoxic activity increased with an increase in the pulse repetition rate and in the total number of pulses per procedure. The greatest death of tumor cells was caused by electromagnetic impact at 50 pulses per second and 50,000 total number of pulses (85% inhibition of the tumor cell proliferation (PI). Decreasing the total number of pulses to 10,000 resulted in lowering the cell damage by EMP (PI was 34%).It was found out during pilot studying EMP impact on the Cisplatin cytotoxicity that the preventive treatment of tumor cells with EMP in the subcytotoxic mode increased the sensitivity of the LLC tumor cells to Cisplatin. Thus, the addition of Cisplatin in the non-cytotoxic concentration of 40 μg / ml (PI - 10%) to the cells after their preliminary exposition to EMP in the subcytotoxic mode (25 pulses / sec with 25,000 total number of pulses; PI - 15%) caused an increase in PI of LLC up to 62%.So, in vitro on LLC murine tumor cells the cytotoxic impact of EMP in certain modes has been shown as well as the increase of Cisplatin cytotoxic activity after preliminary processing the targeted cells with EMP. These modes are planned to be used in the experimental study of the antitumor effect of physical impacts and traditional chemotherapy on biological objects in the *in vivo* test systems, particularly on animals with transplanted tumors.

Keywords: Mouse Lewis Lung Carcinoma Cells, Iimpact Of Powerful Nanosecond Electromagnetic Pulses

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POSTER SESSIONS

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Nanoscale Lipid models to study Membrane Proteins

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Abstract: Developments in the field of X-ray diffraction, such as XFEL (X-ray Free Electron Laser) has become advantageous in studying Membrane Protein's structure and dynamics. For in-vitro studies, membrane protein needs to be reconstituted in a more native like hydrophobic environment. A novel membrane model system, Nanodisc due to its defined size and low mass ratio of lipid to protein, proves to be a suitable candidate for XFEL studies. Nanodiscs are nano-sized lipid bilayer patches held intact with the help of a scaffold protein, MSP (Membrane Scaffold Protein). Engineering this protein will help in creating higher order structures, such as disuphide linked oligomers of Nanodiscs in the case of cysteine mutagenesis. This approach of engineering the protein to create well-ordered oligomeric structures will help in avoiding the normal crystallisation process.

Another recent development in the area of membrane model system is the DEBs (DNA encircled Lipid Bilayer), where the MSP scaffold in Nanodisc is replaced by alkylated DNA[1]. The alkylation provides enough hydrophobicity to accommodate a lipid patch. DNA being a versatile tool for nanotechnological applications, DEBs will ultimately help in enhancing the studies in Membrane protein.

Keywords: Nanodisc, Membrane Protein, DNA Encircled Lipid Bilayer (DEB), X-ray Free Electron Laser (XFEL)XFEL

References

[1]. Iric et al., 2018 ***Nanoscale***, **10**, 18463-18467.

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The Variative Refraction Model as a Tool for the Ionic Strength Dependent Biointerfaces Analysis

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Abstract: Tunable biointerfaces based on the stimuli-responsive materials became more and more popular during last decade because of needs for more and more sophisticated materials for biosensing, bioelectronics, environmental monitoring, biomedicine etc. On the other hand, such type of systems need special methods for their analysis and behavior prediction. One of the efficient instruments for that is the variative refraction model proposed by us elsewhere for explanation the results of surface plasmon resonance (SPR) studies. Traditional SPR analysis is based on the assumption that the magnitude of the SPR response depends on the effective thickness of the analyte layer, which is bound to the receptor layer on the surface. At the same time, the density of both layers is considered to be homogeneous and constant, that is, the change in the SPR signal is due to changes in the parameters of the molecular assembly of interacting molecules in the vertical plane, i.e. thickness. However, the change of SPR signal depends not only on the thickness of the layer, but also on the change in the refractive index inside both layers itself. Thus, variations in the density of the molecular layer can also affect the response value by changing the refractive index inside the layer during or after the formation of interfacial complex. If the thickness of the surface structure is fixed due to the constant form of the interacting components, then the change of SPR signal is a unique function of the compactness of the molecular complex. To exemplify the processes caused changes in organization of biointerface, the immobilization of trypsin molecules on polymer brushes has been investigated. It was demonstrated that in this case the SPR response specific for the trypsin fixed on the brush decreases with increasing of the ionic strength of the solution. Analysis based on the variative refraction approach indicates the unusual behavior of the flexible brushes chains with immobilized trypsin molecules thereon in depends on the presence of free trypsin in solution. At the same time, the refractive index of immobilized trypsin layer demonstrates relatively constant value up to the concentration of NaCl above 0.1 M. The obtained results indicate that the redistribution of flexible fragments of brushes with immobilized trypsin molecules occurs at small levels of ionic strength: the labile chains of the brushes are turned into a volume in the case of the presence of free trypsin molecules in the solution and are displaced to the surface if there are no free trypsin molecules in the solution.

Keywords: Biosensor, Variative Refraction, Biointerface, SPR

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POSTER SESSIONS

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Morphology and Biocompatibility of Nano/Micro-Structured Silicalite-1 Coating

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Abstract: Thanks to their superior mechanical properties, metallic alloys are the most used materials for the fabrication of load-bearing orthopedic implants. However, when exposed to load and corrosive biological environments, these materials release metallic ions, which can cause allergic reactions, inflammation, pain and bone resorption. The metallic debris accumulation is considered to be the main reason for the long-term implant failure [1]. Various types of functional coatings are currently investigated to minimize the release of metallic ions and wear particles as well as to enhance the osseointegration and durability of the implant. Among the others, silicalite-1 films (zeolite, i.e. crystalline oxide with regular pore structure) are a very attractive material for the implant coating due to their low elastic modulus (below 20 GPa) matching the modulus of the host cortical bone (7-30 GPa) [2]. The silicalite-1 films (***SF***) synthesized *in situ* on the surface of Si(100) wafer from a reaction mixture of tetrapropyl-ammonium hydroxide and deionized water were prepared and investigated in this study. The AFM analysis showed that ***SF*** layers consisted of two layers (b- and a,b-oriented crystals) creating a combination of micro- and nano-scale surface morphology. The evaluation of ***SF*** biocompatibility reviled better initial adhesion and proliferation of osteoblast-like MG-63 cells on ***SF*** than on the reference glass coverslips. Moreover, silicalite-1 films also improved the viability of MG-63 cells in comparison with the reference Si(100) substrate. These results suggest that silicalite-1 films can be considered as a promising material for metallic implant coating.

Keywords: Zeolites, Osteoblasts, Viability, Adhesion, AFM

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References

[1]. Vermes C, Chandrasekaran R, Jacobs JJ, Galante JO, Roebuck KA, Glant TT. The effects of particulate wear debris, cytokines, and growth factors on the functions of MG-63 osteoblasts. The Journal of Bone & Joint Surgery 2001;83(2):201-201.

[2]. Johnson M, Li Z, Wang J, Yan Y. Mechanical characterization of zeolite low dielectric constant thin films by nanoindentation. Thin Solid Films 2007;515(6):3164-3170.

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